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Vol. XIII No. 2

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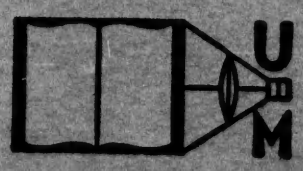

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A GUIDE TO DISSERTATIONS AND MONOGRAPHS AVAILABLE IN MICROFORM

UNIVERSITY MICROFILMS
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AGRICULTURE, GENERAL

A STUDY OF THE PHOSPHORUS SUPPLYING POWERS OF SOME MICHIGAN SOILS

(Publication No. 4692)

Clarence C. Gray III, Ph. D.
Michigan State College, 1952

An investigation was undertaken to determine the phosphorus supplying powers of several representative Michigan soils. Forty-one different soils representing approximately eleven million acres of agricultural land in the southern half of the lower peninsula were selected for greenhouse and laboratory studies. Alfalfa was grown on each of the soils for eleven months under controlled conditions in the greenhouse. Available soil phosphorus was measured by several arbitrary chemical analyses making use of both rapid tests and more quantitative laboratory methods. Phosphorus fixation by the soils was evaluated by two different methods. One method measured the fixation of phosphorus at different rates of application and the other measured the amount of fixation with and without the free iron oxides.

Forty-one Michigan soils varied greatly in their ability to produce alfalfa without added phosphorus. No superiority of any textural group in producing alfalfa was recognized. Yields of alfalfa were increased on all soils by the addition of phosphorus.

Chemical analysis of the alfalfa revealed that the addition of phosphorus to the soils approximately doubled the percentage phosphorus composition. The recovery of phosphorus applied to the soils averaged 38.4 percent.

The amounts of chemically available phosphorus removed by the analytical methods employed varied with the soil and with the extracting agent. No clear relationships between soil properties and soil phosphorus could be established with any of the test methods.

Definite relationships were established between soil phosphorus and alfalfa yields which showed clearly that chemically available phosphorus can be a good measure of the ability of a soil to supply phosphorus. A high degree of linear correlation was found between alfalfa yields and soil phosphorus extracted with reagents containing the fluoride ion. The Bray Adsorbed Phosphorus test, which was well correlated with alfalfa yields, percentage phosphorus composition, and total phosphorus uptake, was the best rapid test method.

Phosphorus fixation studies of twenty-two soils using several rates of applied phosphorus revealed no apparent relationship to any of the measured soil properties. The quantities of retained phosphorus varied with the soil and with the amounts of applied phosphorus. The character of the fixation curves suggested that the mechanisms of fixation differed.

The removal of free iron oxides from the soils reduced phosphorus fixation from 0.6 percent to 75 percent. No relationship, however, could be established between the amount of fixation and free iron oxide content.

A classification of forty-one Michigan soils as to their phosphorus supplying powers was presented based on yield and composition of continually cropped alfalfa, soil tests for chemically available phosphorus, and phosphorus fixation studies.

Microfilm copy of complete manuscript of 109 pages, $1.36. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-306.

THE EVALUATION OF PHYSICAL FACTORS IN RELATION TO LAND USE: A STUDY OF GOGEBIC AND ONTONAGON COUNTIES, MICHIGAN

(Publication No. 4695)

Clifford R. Humphrys, Ph.D.
Michigan State College, 1952

Gogebic and Ontonagon Counties are considered typical of the cut-over region of the upper peninsula of Michigan. Early exploration and development was initiated in 1840 by prospecting for copper and iron. Beginning in 1890 the lumbering industry took interest in the vast stands of virgin pine which became accessible after the railroads were extended into the area. The supply of pine lasted for about twenty years and now the last of the virgin hardwood is being cut.

After the pine was cut, farmers were encouraged to settle much of the burnt-over stump land and some of these original pioneer settlements prospered and are now stabilized communities.

In 1900 the United States Government began to acquire land for a federal forest and the acquisition program was aided by the reversion of large tracts of land to the State by tax delinquency. The ownership of most of the tax reverted land in Gogebic and Ontonagon Counties was conveyed to the United States Government by exchange for other lands located within State forest boundries elsewhere in the State.

With the advent of the automobile and a primary system of state and county highways, the area was opened to development for recreation. Intensive utilization of the lake region of Gogebic County

commenced in 1940 as the Wisconsin Land O' Lakes area was extended northward.

The object of this study is to review the historical, economic and physical characteristics of Gogebic and Ontonagon Counties and to attempt to project any land use trends that may exist. In the final analysis of present and future land use, it also appeared advisable to compile an ideal land use map based upon the natural characteristics of the land. A summary of acreage in each of the major land uses is hereby listed:

	Present Land Use[1] (Acres)	Ideal Land Use[2] (Acres)
National Forest	406,160	374,000
Private Forest	246,720	398,000
County Forest	35,720	
Farm Land	240,800	405,000
Mineral Land	118,040	16,000
Speculation	148,640	
Public Recreation	45,960	87,000
Private Recreation	60,040	150,000
Water Power	43,490	43,000
Game Management		93,000

1. Based upon present intent of ownership.
2. Based upon natural land characteristics.

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A STUDY OF THE LIPOLYTIC ENZYMES OF RAW SKIM MILK AND SEPARATOR SLIME

(Publication No. 4869)

Harvard Glen Nelson, Ph.D.
University of Minnesota, 1952

The hydrolysis of butterfat by lipase produce fatty acids and glycerol. The short-chain fatty acids of butterfat, especially butyric acid, are characterized by unpleasant flavors and odors and when produced in milk bring about a defect known as rancidity.

This experimental study was planned with the primary object of obtaining more information concerning this problem so that it could be more fully understood and ultimately controlled. It was hoped that this aim could be achieved by analyzing the characteristics and properties of the fat-hydrolyzing enzymes that cause rancidity in milk.

Enzymes from two sources were studied. The fat-hydrolyzing enzymes from separator slime were compared with those of skim milk.

The separator slime was subjected to various treatments prior to being tested for lipase activity. Lyophilized (freeze-dried) separator slime proved to be the most satisfactory form of separator slime to be used for these studies.

Experimental conditions were adjusted so that: (1) preservatives were not used, (2) bacterial activity was limited because of the short reaction time of 1 hour, (3) reaction rate was proportional to enzyme concentration, (4) the reaction media were buffered to pH of maximum activity in most cases, and (5) the activity of the lipase was measured determining the increase in titratable acidity due to hydrolysis of the substrate. The titration was done using O.1N NaOH and titrating to an end point of thymolphthalein in an alcohol-ether solution.

The results may be summarized as follows:

Separator slime is a much richer source of lipase than is either skim milk or cream. The process of separation plays some role in determining the amount of lipase in separator slime and in skim milk since there was considerable variation in the amount of lipase activity found in separator slime and skim milk. It was not possible to determine the cause of all these variations.

The lipase of separator slime can be transferred to an aqueous solution by means of homogenization and centrifugation. Weak saline solutions would not preferrentially extract some lipase from separator slime. The salt solutions did not inhibit the activity of the enzymes.

Lyophilizing of separator slime produced a powder that was rich in lipase and had good keeping qualities. Undried separator slime exhibited poor keeping quality as far as lipase activity was concerned.

The leucocytes and cell debris as obtained from cow's blood and from locallized infections produced on young calves did not possess a lipase similar to the lipase found in separator slime.

The pH-activity curves as influenced by a variety of experimental conditions have been described. The pH optima obtained were as follows: separator slime using tributyrin as substrate showed optimum lipase activity at pH 8.5 and 7.9, skim milk lipase demonstrated optimum activity at only pH 8.5.

There was greater activity of the lipase systems of separator slime and skim milk on tributyrin than on triacetin, tricaprylin, trilaurin or tristearin. The lipases from these two sources failed to hydrolyze triolein. The lipases of separator slime hydrolyze triglycerides more readily at pH 8.5 than at pH 7.9.

The lipases of separator slime hydrolyze methyl and ethyl esters of mono-hydroxy alcohols readily while lipases of skim milk cause little or no hydrolysis of these same substrates. The long-chain fatty acids of methyl and ethyl esters of mono-hydroxy alcohols were hydrolyzed more readily at pH 7.9 than at pH 8.5. The lipase system was more active on esters in which the alcohol was glycerol than with esters which included methyl and ethyl alcohols.

The lipases of separator slime and skim milk were inhibited by dilute concentrations of formaldehyde.

Differences in characteristics of the lipase system of separator slime indicate that there may be more than one lipase present in the separator slime. The results suggest that skim milk does not possess all the lipases found in separator slime.

The data obtained are presented both in tabular and graphic form.

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THE COMPARATIVE EFFECTIVENESS OF SELECTION IN SWINE BEFORE AND AFTER TESTING THEIR PROGENY

(Publication No. 4883)

Paul O. Stratton, Ph.D.
University of Minnesota, 1952

The records of performance of two inbred lines of swine in the Minnesota swine breeding project accumulated over a 15 and 10 year period for the two respective herds, the Minnesota No. 1's and Minnesota No. 2's, were analyzed to compare the effectiveness of selection before and after progeny testing. These two inbred lines of swine were developed from crossbred foundations. The two lines to date have coefficients of inbreeding of approximately 40 and 30 percent, respectively.

The two factors that determine annual improvement from selection in any closed population are (1) the average genetic superiority of the animals selected to become parents over the group from which they were chosen and (2) the average interval between generations. The procedure was to compare the genetic progress expected under the present breeding herds maintained by using both gilts and re-selected sows, with the genetic progress to be expected from theoretical gilt herds for both lines. As a means for comparison, a theoretical gilt herd for each line was formulated by a method of proportion. Comparisons of the merits of performance in five traits (1) number of pigs farrowed alive, (2) number of pigs weaned, (3) body conformation, (4) feed efficiency, and (5) growth rate were made between the actual herds and theoretical gilt herds within each of the two respective lines. Predicted rates of improvement for the five performance traits were determined giving due consideration to the selection differentials, the heritability estimates, and the average interval between generations.

The annual genetic improvement expected to result from the increased accuracy of selection due to the progeny test in the actual herds was generally offset by the increased interval between generations. A comparison of the expected genetic gain due to selection for number of pigs weaned, body score, feed efficiency, and growth rate in the theoretical gilt herds and in the actual herds within each line indicated that more annual genetic gain would have been realized in the theoretical gilt herds. The expected annual genetic improvement for litter size was greater in the actual herds than in the theoretical gilt herds. It appeared from this study that equally satisfactory performing lines, using a breeding herd of gilts, are to be expected with similar practices of selection and mating as were employed in the development of the inbred lines of swine studied.

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FACTORS AFFECTING PERSISTENCY OF MILK PRODUCTION IN DAIRY CATTLE

(Publication No. 4889)

Sana Ullah, Ph.D.
University of Minnesota, 1952

Persistency of lactation has been considered as one of the important characteristics of dairy cattle having great influence on total production. Several factors, genetic as well as nongenetic, are known to have influence on the persistency of milk production. An effort has been made in the present study to find out the effect of certain genetic as well as non-genetic factors on persistency.

A statistical analysis of 222 records of 134 Holstein purebred animals, 7 pairs of identical twins and one set of identical triplets of the University of Minnesota herd at St. Paul and Rosemount from 1909-1952 has been made. Factors affecting the coefficient of variation from milking to milking, its relation with persistency, heritability estimates for coefficient of variation, factors affecting persistency and heritability estimates of persistency of lactation are presented.

The coefficient of variation from milking to milking is a hereditary character and is influenced by several environmental factors. Important environmental factors found to affect the coefficient of variation were mastitis, heat periods, surgical operations, illness, change of surroundings and environments, change of management conditions, poor nutrition and irregularity of milking, all of which invariably raised the coefficient of variation. Other things being equal, high yielding animals were found to have a lower coefficient of variation than low yielding animals. The heritability estimate of the coefficient of variation in the broad sense obtained by "Isogenic lines" method from 7 pairs of identical twins was .93.

Dairy animals having a high coefficient of variation were found to be less persistent. The coefficient of correlation between persistency of lactation and the coefficient of variation was -.4728 ± .1634 in the case of 3x-368 day records and -.5445 ± .1112 in the case of 2x-305 day records.

Persistency of lactation decreased as the number of completed lactations increased up the sixth lactation with 3x-368 day records and up to the third lactation with 2x-305 day records. Cows milked three times a day were more persistent than those milked twice a day, and those milked two times a day were more persistent than animals milked once a day.

Short calving interval depressed the persistency index while long calving interval increased persistency.

Heritability estimates for persistency of lactation estimated by the intra-sire regression of offspring on dam method were .35 ± .17 for 3x368 day records and .27 ± .07 for 2x-305 day records. Heritability was .84 when estimated by identical twin method. The differences in these heritability estimates indicate that dominant and epistatic gene effects may play an important role in addition to the additive effect of genes.

Higher initial yield was associated with lower persistency. The coefficient of correlation and partial correlation between initial yield and persistency was found to be -.49 ± .13 and partial correlation between initial yield and persistency when production was kept constant was found to be -.80. The correlation coefficient between initial yield and total production was found to be .51 ± .12 and the partial correlation between them, when persistency was kept constant, was found to be .82. The correlation coefficient between persistency and total production has been found to be .4132 ± .1311. Partial correlation between persistency and total production, when initial yield was kept constant, was observed to be .8713. All these correlations have been observed to be significant. The above facts show that initial yield (maximum production) and persistency have a very great effect on total production. Improvement in these characteristics will lead to greater and more economical production.

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AGRICULTURE, FORESTRY AND WILDLIFE

CHANGES IN SOME VEGETATION, SURFACE SOIL AND SURFACE RUNOFF CHARACTERISTICS OF A WATERSHED BROUGHT ABOUT BY FOREST CUTTING AND SUBSEQUENT MOUNTAIN FARMING

(Publication No. 4497)

Robert Earl Dils, Ph.D.
Michigan State College, 1952

For many years in the Southern Appalachian Region of the United States cutting the forest cover from steep slopes and subjecting the land to mountain farming has been common practice.. The recent increased emphasis on water conservation and erosion problems has posed numerous questions as to the effect of this practice on the water resource.

This study sought to determine some of the modifications of surface runoff characteristics as well as some of the resultant changes in vegetation and surface soil brought by such treatment. The Little Hurricane Watershed at the Coweeta Hydrologic Laboratory in southwestern North Carolina provided a unique opportunity for the study. The forested watershed, set aside for experimentation by the Forest Service, United States Department of Agriculture in 1934, was calibrated for six years, after which the forest cover was removed and steepland farming practices applied. Corn was planted on part of the area, cattle were grazed on a second portion and second growth forest was permitted to develop on the remaining land. An additional control was provided by a similar watershed nearby which was allowed to remain in original forest cover.

To determine the changes, a vegetation survey, analyses of the physical characteristics of the surface soil and surface analyses were made.

A 1951 vegetation survey indicated that, given protection, shrubs and hardwood trees soon provide a vegetal cover on cutover and cultivated areas. In heavily grazed pastures noxious and unpalatable weeds and herbaceous species, frequently associated with the mis-use of land, invade rapidly.

Measurements of soil losses indicated an increase of approximately 12 times, with the greatest percentage of loss associated with cultivation. Infiltration rates decreased moderately, except in the heavily-grazed area, where the decrease was pronounced. The analyses of soil samples collected from five sites and two surface layers showed decided differences between forest-covered, grazed and cultivated soils in aggregation, organic matter, volume weight and permeability. As a consequence of cultivation or grazing, total porosity and capillary porosity values increased while non-capillary porosity decreased. All analyses appeared to indicate a degrading in soil-water relations.

Forest cutting and subsequent mountain farming effected significant changes in surface runoff characteristics. This percentage more than doubled for the entire watershed with a probable increase of 6 to 8 times indicated in the heavily-grazed area. Marked increases in the magnitude and frequency of flood peaks also resulted. Prior to treatment, the distribution graph showed a broadly inverted V-shaped pattern with the peak occurring 35 minutes after runoff began. The post-treatment period presented a needle-shaped pattern with the flood peak occurring only 15 minutes after runoff appeared, indicating the much higher flood potential brought about by the greatly increased volume of water coming from the area in a very short period of time.

The results of this study show that cutting the forest cover from steep slopes and applying mountain farming practices to the land has a deleterious effect on the water resource, soil-water relations, and on the quality and quantity of the vegetal cover.

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AGRICULTURE, PLANT CULTURE

SOME EFFECTS OF MALEIC HYDRAZIDE ON CERTAIN PHYSIOLOGICAL RESPONSES OF CELERY (APIUM GRAVEOLENS)

(Publication No. 4696)

Hezekiah Jackson, Ph.D.
Michigan State College, 1952

The effects of foliage sprays of various concentrations of maleic hydrazide on the growth and development of Cornell 19 celery plants were determined under field and greenhouse conditions. Time of application, cold exposure of plants, and soil nitrate levels were considered. Storage tests were also conducted to determine the effects of maleic hydrazide applied as a preharvest foliage spray on the sugar and nitrogen content of Cornell 19 and Utah 15 varieties of celery which were stored for various periods of time at 33 $\pm$ 2° F. Finally a series of fresh tissue analyses were carried out during the growing season to determine the effects of maleic hydrazide treatments, soil nitrate levels, and temperature exposures on the soluble nitrogen content of maturing Cornell 19 celery plants.

Foliage sprays of maleic hydrazide favored the development of seedstalk initials in Cornell 19 celery when applied at 50 and 100 ppm to plants which were from 13 to 16 weeks old. In striking contrast, when applied at 500 to 1000 ppm to older plants, seedstalk elongation was inhibited. Maleic hydrazide did not have comparable influences on initiation and inhibition of seedstalk formation and elongation, respectively, under greenhouse and field conditions. Low night temperature (40 $\pm$ 5° F) exposures of young celery plants had a pronounced influence in hastening the date and increasing the per cent of seedstalk formation in both field and greenhouse tests. A high soil nitrate level (75 ppm) favored seedstalk growth and development under field conditions, but 100 ppm of soil nitrate under greenhouse conditions had an inhibitory effect on the same responses.

Celery plants which were exposed to low night temperatures and low levels of soil nitrates before transplanting to the field generally had a greater physiological tolerance for comparable spray concentrations of maleic hydrazide. The lethal injuries induced by maleic hydrazide treatments followed a definite pattern. Initial injury occurred as a chlorosis on the inner petioles and leaves, followed by a discoloration of the older petioles and leaves, and subsequent death of the plants.

Storage tests with two varieties (Cornell 19 and Utah 15) of celery were conducted wherein foliage sprays of maleic hydrazide (500, 1000, and 2500 ppm) were applied prior to harvest. The celery which was harvested and subsequently stored at 33 $\pm$ 2° F for various periods of time was analyzed for total, reducing, and non-reducing sugars; and for total and nitrate nitrogen. No significant alterations in total or nitrate nitrogen were observed. However, significant increases and decreases in sugars were characteristic of some of the maleic hydrazide treatments, but not others, and several inconsistencies were noted in the results of the two storage tests.

Tissue analyses of celery petioles harvested from plants of various ages and grown at 10, 20, and 75 ppm of soil nitrate, revealed that foliage sprays of maleic hydrazide of 100 to 250 ppm decreased the soluble nitrogen content.

The results of the present research concerned with the effects of maleic hydrazide in the development of celery plants is discussed in view of the reports of others relative to the influence of this chemical on the vegetative and flowering responses in plants. It is significant that as herein reported the formation of seedstalk in celery plants has been promoted by foliage sprays of maleic hydrazide even with plants not previously induced to flower by cold treatments.

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SOME EFFECTS OF FOLIAR SPRAYS OF MALEIC HYDRAZIDE ON THE POST-HARVEST PHYSIOLOGY OF POTATOES, ONIONS, AND CERTAIN ROOT CROPS

(Publication No. 4698)

Donald Robert Paterson, Ph.D.
Michigan State College, 1952

Single aqueous sprays of 500, 1000 and 2500 ppm of maleic hydrazide, benzo-thiozole-2-oxyacetic acid and 2,4,5-trichlorophenoxyacetic acid were applied to field plots of potatoes, onions and six root crops at different intervals before harvest in 1950 and 1951. After yields were determined, the various crops were placed in 35°, 45°, and 55° F storage rooms for several months. The potatoes and onions were analyzed both before and after this storage period for dry matter, total nitrogen, starch, reducing sugar, and non-reducing sugar. The amount of storage sprouting and breakdown as well as the loss in weight due to respiration, transpiration and other vital processes was determined at the end of the storage period for the various crops.

Five hundred, 1000 and 2500 ppm of maleic hydrazide applied to the foliage of potato plants one to seven weeks before harvest were effective in prolonging dormancy of Irish Cobbler, Pontiac, Russet Rural, and Sebago tubers held in storage for seven months at temperatures of 45° and 55° F. Complete inhibition of sprouting resulted from single preharvest foliar sprays of 2500 ppm of maleic hydrazide applied four to seven weeks before harvest and the inhibition was more pronounced than that obtained with preharvest foliar treatments of 2,4,5-trichlorophenoxyacetic acid or with post-harvest applications of the methyl ester of alpha-naphthaleneacetic acid. Maleic hydrazide induced sprout inhibition was accompanied by an absence of shriveling with

little or no deterioration of quality and with no reduction in yield of U.S. No. I potatoes in 1950. Reductions in yield from the spray treatments were detected, however, in 1951 indicating the necessity for proper timing of application of the chemical if satisfactory results are to be obtained. Apical dominance of both tubers and individual sprouts on the tubers was destroyed. The percentages of reducing and non-reducing sugars were lower in maleic hydrazide treated potatoes stored at 45° F in 1950, while extensive storage studied of treated and non-treated potatoes held at 35°, 45°, and 55° F the following year showed no differences in reducing sugar, non-reducing sugar or starch percentages. Early post-emergency sprays of maleic hydrazide at 2500 ppm did not reduce storage sprouting of potato tubers, and low concentrations of maleic hydrazide applied shortly before harvest stimulated sprout growth on potato tubers.

Sprays of 500, 1000 and 2500 ppm of maleic hydrazide applied to the foliage of onion plants seven to ten days before harvest resulted in marked reductions of sprout and root growth during storage. Foliage sprays of maleic hydrazide at 2500 ppm applied three weeks or more before harvest resulted in an increase in storage breakdown of all onion varieties. There was a decrease in the percentage of reducing sugar in the control samples of Y-40 onions over a four and one-half month storage period, while similar samples treated with a 2500 ppm foliar spray of maleic hydrazide showed no decrease in reducing sugar. No alterations in the amount of dry matter, total nitrogen, or non-reducing sugar in the Y-40 onions was induced by the maleic hydrazide treatments. The percentage of weight loss not resulting from sprouting, rooting or breakdown was nearly identical when both treated and non-treated Y-40 onion bulbs were held under bulk storage conditions.

Preharvest foliar sprays of maleic hydrazide at 2500 ppm applied ten days before harvest reduced the amount of sprout growth of carrots, beets, rutabagas, turnips, and sugar beets held in storage at 55° F.

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LEAF ANALYSIS AND GROWTH OF MONTMORENCY CHERRY TREES (Prunus cerasus, L.) AS INFLUENCED BY SOLAR RADIATION AND INTENSITY OF NUTRITION

(Publication No. 4709)

Edward Louis Proebsting, Jr., Ph.D.
Michigan State College, 1952

One-year-old Montmorency cherry trees were grown in sand culture with five balanced nutrient solutions ranging in concentration from zero to 8,000 ppm. Varying conditions of solar radiation were provided by moving the trees at various intervals between full sun and shade houses which were constructed with camouflage netting. Leaf analyses and growth records were obtained, and their relationships to each other and to the treatments were discussed.

Leaf analysis values for the individual elements did not increase proportionately with the concentration of the nutrient solution. Nitrogen and manganese values increased in proportion to the nutrient solution concentration, but the magnesium content decreased as the nutrient solution concentration was increased. Leaf phosphorus, potassium, calcium, and iron showed an irregular relationship with nutrient solution concentration, indicating that the absorption of phosphorus, potassium, calcium, magnesium, and iron was more dependent upon the physiological relationships among the nutrients than upon the absolute concentration of the element in the external solution.

Marked differences in leaf analysis were induced by differences in solar radiation. These differences were of a complex nature and were influenced by other factors, such as temperature, so that the responses of one year could not be repeated in a succeeding year. On the basis of our present knowledge, prediction of the effect of solar radiation upon leaf composition probably would not be successful.

Leaf nitrogen showed a close relationship with growth responses. Very marked depression of growth was associated with leaf nitrogen greater than 3.5%, in the full sun in 1949. At 30% S.R. and 50% S.R. depressions in growth occurred with leaf nitrogen contents higher than 2.9%. There was no apparent relationship between the absorption of the other nutrient-elements and growth, as affected by solar radiation and nutrient solution intensity.

The relationship between leaf analysis and the nutrient solution and solar radiation treatments was different in 1949 from 1950. This difference appears to be associated with temperature more than solar radiation.

The conditions most favorable for the growth of Montmorency cherry trees vary in regard to the measurement of growth as follows:

a. Terminal growth is favored by moderate temperatures and low light conditions.

b. Increase in dry weight is the greatest with warm temperatures and full intensity of solar radiation.

c. Reduced solar radiation failed to stimulate terminal growth when storage reserves had been used in shoot growth prior to reducing solar radiation.

d. Higher concentration of nutrient solutions were more toxic at higher temperatures and reduced solar radiation. With normal solar radiation and warm temperatures (conditions favoring dry weight increase) a total salt concentration of 2,000 ppm resulted in maximum dry weight increase. Reduction of the solar radiation to 50% resulted in maximum dry weight increase at a total salt concentration of 1,000 ppm, and at 30% S.R. the best growth was observed when no nutrients were added.

Trees growing in high solar radiation are more capable of utilizing higher intensities of nutrient elements than are trees growing in reduced solar radiation. However, in order to produce a given amount of dry matter it is more important that the trees have optimum conditions of nutrition where solar radiation is relatively low than where solar radiation is high.

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THE STRAWBERRY VIRUSES IN MINNESOTA

(Publication No. 4881)

Robert Lawrence Skiles, Ph.D.
University of Minnesota, 1952

Strawberry viruses are present in nearly all commercial strawberry varieties grown in Minnesota. Healthy-appearing strawberry plants representing 23 commercial varieties and 4 clones of Minnesota seedlings were collected in 19 counties in Minnesota. Each plant was inarch-grafted to a healthy Fragaria vesca indicator plant (East Malling clone) to determine the percentage of plants infected with viruses. Symptoms of virus-infection usually appeared in the indicator plants within 4 to 8 weeks after grafting. The number of plants tested ranged from 10 to 30 in such popular varieties as Arrowhead, Beaver, Dunlap, Premier, Robinson, and Streamliner, in other varieties smaller numbers were tested. Twenty-one out of 23 varieties and 4 clones of Minnesota seedlings were 100 per cent infected and 5 of the remaining varieties were 37.5 to 92 per cent infected. Brilliant was the only variety that indexed virus-free.

There were 6 distinct viruses isolated from the commercial plants on the basis of symptoms produced in the F. vesca plants. The symptom of each virus, respectively, was epinasty, chlorosis, dwarfing, chlorotic spotting, necrotic spotting, and ringspot. The last symptom has not been previously associated with virus infection. These 6 viruses, either alone or in various combinations, produced symptoms of 10 different types, designated as Minnesota virus classes. The viruses in each class were virtually state-wide in distribution, but some were limited to certain strawberry varieties. The most prevalent classes, all varieties considered, were the two that were characterized, respectively, by a combination of epinasty and chlorosis, and a combination of epinasty, chlorosis, and dwarfing.

The characteristic symptoms of each Minnesota class were compared to those produced by previously described viruses. Various classes appeared to be analogous to either virus type 1 or 2, or combinations of the two, in Demaree and Marcus' classification. The symptoms of one Minnesota virus class (dwarfing and chlorosis) have not been previously described. The British viruses 1, 2, and 3, either alone or in various combinations, were also analogous to certain Minnesota virus classes. No analogues to 4 classes were found in the British system.

Indicator plants were inoculated, respectively, with the xanthosis and stunt viruses isolated from diseased plants for comparison with the viruses isolated from the healthy-appearing plants. None of the viruses obtained from the latter produced symptoms in F. vesca that resembled xanthosis or stunt. Therefore, it appeared that these two viruses were not present in masked forms, although they can be isolated from diseased plants. These comparative studies will be of value in future strawberry virus investigations.

Several indicator plants developed different symptoms in parent- and runner-plants when grafted to various commercial plants. The parent leaves became epinastic and chlorotic, and the runner leaves became chlorotically-spotted. This indicates that the causal viruses moved in opposite directions in the indicators.

F. vesca plants were grafted to several plants of the Wisconsin 537 variety and the Minnesota seedling selection 40-7, all of which expressed symptoms of June yellows. In each case, symptoms corresponding to Minnesota virus class 4 and Demaree and Marcus' type 2 virus developed in the indicators. Thus, it appeared that June yellows, hitherto considered to be of genetic origin, was associated with virus infection.

Several Potentilla argentea plants that appeared to be virus-infected were grafted to F. vesca plants. However, no symptoms developed in the indicators and it was concluded that the Potentilla plants were not infected with a strawberry virus.

F. vesca indicator plants, some of which were inoculated with the xanthosis virus, were inoculated with Rhizoctonia sp. to determine the effect of the virus on root-rot susceptibility. The roots on the virosed plants were rotted considerably more than were those on the virus-free plants. It is apparent, therefore, that the virus predisposed the plants to root-rot by Rhizoctonia.

The evidence presented in these studies indicates that the strawberry viruses play a role in the degeneration of commercial strawberry varieties.

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A STUDY OF THE EFFECTS OF DESICCATION AND LOW TEMPERATURES ON THE EXTENT OF WINTER INJURY TO CERTAIN WOODY PLANTS

(Publication No. 4890)

Jacob Wilner, Ph.D.
University of Minnesota, 1952

The purpose of this exploratory study was to determine certain conditions which influence the survival of woody plants during winter on the Canadian prairies. Since winters on the prairies are characterized to a great extent by severe cold and drying winds, the relative effects of desiccation and low temperatures on the extent of injury of woody plants were investigated.

Fifteen woody plants representing species and varieties used on the prairies for windbreak purposes and fruit production were studied at University Farm, St. Paul, Minnesota. Twig samples were collected at the beginning of study from each of the 15 trees. The basal ends of these twigs were sealed with grafting wax to prevent moisture losses from cut surfaces. The twigs were exposed on a rack to outdoor conditions for 87 days, from December 20 to March 16. The extent of water losses of twigs was determined at the end of 36, 49, 63 and 87 days of exposure.

At the end of 63 and 87 days, freezing injury was studied both on twigs which had been exposed to the natural outdoor temperatures and on twigs which had subsequently been exposed in addition to artificial low temperature conditions of -15, -30, and -45° F. The relative rating of hardiness of the plants studied was based on the extent of their tip killing in inches.

The possible relationship of several plant characters and meteorological factors to hardiness of the selected plants was also studied. These were as follows: the water content of mature twigs; the thickness of cuticle, periderm and bark; the number of buds and lenticels; the relative humidity of the air and temperatures above and below freezing.

These studies revealed the following:

1. During outdoor exposure greater losses of water were shown by twigs during the periods with temperatures above 32° F., indicating that desiccation occurs principally at temperatures above freezing. This would suggest that considerable injury to woody plants in the chinook regions of the prairies might be due to desiccation, which may take place as the result of frequently occurring mild spells.
2. The main differences in tip killing were attributable to low temperatures and to trees, but not to the differences in exposure to desiccation that were included in this experiment. Low temperature treatments following outdoor exposure caused more tip killing than did outdoor exposure alone. The 15 trees, however, did not respond the same to these low temperature treatments, and some were able to withstand the most severe low temperatures without suffering serious tip killing, eg. Caragana, green ash and Dolgo apple. This would suggest that the general survival of trees during winter on the prairies may be increased by careful selection of certain species and varieties.
3. Since the tip killing rating following the artificial freezing tests appeared to correspond in general with hardiness ratings found from experience by horticulturists, it is apparent that such artificial tests may be regarded as more rapid and fairly reliable guides to hardiness ratings of woody plants.
4. The hardier plants within each group of windbreak and fruit species were not distinguished in this study from the less hardy by any of the plant characters.
5. This preliminary study has revealed the desirability of conducting more intensive research on certain phases of hardiness problems with larger samples and a wider variety of material.

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ANATOMY

ADRENAL ASCORBIC ACID CHANGES IN THE GOLDEN HAMSTER

(Publication No. 4689)

Bernard Carl Wexler, Ph.D.
Stanford University, 1953

A study has been made of various mechanisms of ACTH release in the golden hamster (Cricetus auratus). Single injections of diethylstilbestrol were given to male and female hamsters, and their adrenals analyzed for changes in ascorbic acid content according to various quantitative chemical and histochemical methods indicative of ACTH release. A single injection of stilbestrol caused a marked release of ACTH in the female but only a moderate response in the male hamster. This was held to be indicative of a possible blockage of ACTH release by testosterone. Histochemical analyses for adrenal ascorbic acid revealed a somewhat different morphological distribution of ascorbic acid in the golden hamster than occurs in other species.

Gonadectomy caused an increase in adrenal ascorbic acid content to twice the amount ordinarily

found in the intact hamster; also, castration removed the block on ACTH release.

Intact hamsters were given a single injection of ACTH and it was found that there was no blockage of exogenous ACTH in the male hamster, whereas there was a block to this trophic hormone when given exogenously in the female.

The implications these findings may have in regard to a larger study in which long-term treatment of the golden hamster with stilbestrol caused the production of renal tumors in the male, and nephritis in the female are discussed. Included in this discussion are remarks concerning the interrelationships between the pituitary gland, the adrenal glands, and the gonads.

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ANTHROPOLOGY

DECISION-MAKING IN RELATION TO PROPERTY ON A COSTA RICAN COFFEE ESTATE

(Publication No. 4712)

Thomas Leonard Norris, Ph.D.
Michigan State College, 1952

The questions with which the study are concerned center in the land, its uses, and the relations which obtain among the occupants of the land in achieving those ends and goals towards which life on Aquiares, a large coffee hacienda, is oriented. More specifically, the following queries were formulated:

1. To discover how the population of the coffee estate is organized in terms of coffee production.
2. To describe the system and its subsystems, especially with regard to how peers, subordinates and superordinates are identified in terms of the hierarchical authority structure of the local community.
3. To determine how relationships to locally conceived categories of property affect one's membership and position in a sub-system within the total structure of interpersonal relations on the estate.
4. To describe how decisions are made within the larger agricultural system.
5. To discover which structural positions in each sub-system are most strategic in the decision-making process.

Aquiares, one of the largest coffee haciendas in the Turrialba Valley of Costa Rica, lies at the southeastern base of Turrialba volcano. The estate contains 2,369 acres and supports a population of 1372 persons. Seventy-eight families operate coffee lots as tenant farmers or sharecroppers (colonos), and about one hundred and thirty families are day-wage employees.

The population is organized primarily in terms of coffee production. Three systems characteristic of large Latin American hacienda-type estates are found, namely, administrative, managerial, and peon systems. A fourth, the colono system, is basically a tenant farmer or sharecropping operation, but is not common in other places in Costa Rica. Its importance for this study lies in the fact that almost half of the total population on the estate are colonos and their families. Furthermore, more than half of the land in coffee is operated under the colonia system.

The rationale which accounts for the division of the labor force into systems such as the administrative, managerial, peon, and colono is derived from the place which control of or possession of property occupies as that measure recognized by the population which distinguishes these systems. The administrative system is so designated because its members maintain the greatest degree of control over the property in question, namely the estate. Managerial status permits one, by a system of tips, bonuses and higher wages to accumulate not only more property than peons or colonos, but also certain kinds of property to which prestige value is attached. Few colonos or peons can purchase a small independent farm, but this goal is within easy reach of managerial employees. Difference in status between these systems is further reflected in other items such as housing, radios, urban vs. peon style clothing, iron stoves, shoes, etc.

Structural positions within each system are ordered by the general organization of the estate. In the administrative system, there is a unilinear chain of authority and line of communication between the overseer, foreman of the beneficio, chief carpenter and some specialists. However, the overseer is in more direct control of the total labor force since he makes the initial assignments of laborers. Competition among managerial employees is minimized, however, by a highly explicit division of labor. The colono has higher status as a rule than the peon and this status differential can be traced to proximity to and control of property or the means of production.

Only some decision-making processes involve the modification of the behavior of others from normal, expected channels. Usually, decision-making in Aquiares is a highly explicit procedure in the sense

that there is seldom any doubt as to the locus of authority in the situation under question. A typical decision of this type would be that of the overseer made each day relative to the work assignments for the current day. Three unusual decision-making situations are introduced into the study to illustrate the dynamics of the decision-making process when dealing with new and unique problems. Such situations are particularly relevant to the change agent since the consequences of his program imply modification of established and traditional behavior patterns. The relations obtaining among positions of varying status in the general authority hierarchy of the estate were altered but slightly in these atypical situations. Thus there is something of a halo effect emanating from the general organization and influencing the course of events in secondary activities.

This study, in summary is a descriptive and analytic account community organization around one major theme: coffee production. The problems treated in the study are designed to further existing knowledge of Latin American social systems as well as to provide a basis for applied programs.

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NORTHERN IBO SOCIAL STRATIFICATION AND ACCULTURATION

(Publication No. 4956)

Linvill Fielding Watson, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: WARD H. GOODENOUGH

The five million Ibo of Nigeria have a reputation as a "democratic" people. Many of the maximally acculturated younger Ibo are participating aggressively and effectively in non-traditional activities, especially as urban migrants and outside of the Ibo region proper. The object of this study has been to clarify the traditional Ibo stratification and the impact of modern conditions in modifying them.

Acculturation results in Ibo emphasis upon four new modes of social categorization, which tend to coincide: (1) "educated" versus "illiterate"; (2) "country" or "bush"; and "youth" versus "the old people". All these contrasts are overriding the former stratification lines, often reversing the prestige rank of individuals from low to high and high to low. A proverb has recently become current among the older generation: "Nowadays the food of young people is richer than old people's food", implying the comprehensive reallocation of advantages, inverting traditional relationships.

Ibo tradition has been democratic in the sense that ranking is achieved rather than ascribed, power exists only in small units, and a relatively large number of persons may aspire to maximum dignity as Ozo titled men. The former rationale of investing lineage ancestors with ultimate sacredness, and assigning to them ultimate ownership of the land, was inherently susceptible to decentralizing tendencies.

About two thousand "towns" were each completely autonomous in terms of formal structure. Each Ozo titled man was directly responsible for administering a basic residential and labor unit (the compound), and was an intermediary with the dead ancestors. Within the quarter or "town" as a whole authority was divided and balanced among many titled men.

A conclusion has emerged from this study, which might be examined comparatively in many other contexts besides the Ibo. Fluidity of rank status, for individuals or groups, is associated with their movement in space, which may or may not involve abandoning one set of criteria for fixing rank and substituting another discordant set of criteria. In traditional Ibo logic, the category "slave" and the process of moving residence from place to place were interdependent. Those who moved became slaves, and demand for slaves induced patterns of forced movement, with maximum use of enslavement as a social sanction. At the present time, the new category "boys who go to the cities" (our term "diaspora") stands for a tendency to repudiate the whole former set of criteria for fixing rank, with the adoption or emergence of contrasting criteria.

Among the Ibo in general, former consensus as to rank status criteria has been broken under acculturation, and a new consensus has not yet crystallized. The new criteria which the intrusion of a foreign culture makes available have been adopted more rapidly and enthusiastically by those to whom the traditional criteria were not advantageous.

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A STUDY IN THE RANGE OF SOLUTION OF ORBITAL ELEMENTS OF MINOR PLANET 534, NASSOVIA, FOR SHORT ARCS, BY THE METHOD OF LAPLACE

(Publication No. 4944)

Alvin Hughlett Mason, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: C. P. OLIVIER

The minor planet 534, Nassovia, was discovered on 19 April 1904 by Dugan at Konigstuhl. At opposition it was near 13.0 magnitude.

Orbits have been calculated by Bauschinger[1], Cohn[2], Strehlow[3], and Hanina[4]. The latter calculation is a definitive orbit based on eight oppositions from 1921 to 1949, including perturbations of Jupiter and Saturn.

The investigation of which this paper is the subject determines the range of solution of the orbital elements of this asteroid for two arcs of approximately equal length and of nearly identical epoch. The results afford an index to the order of precision attainable in orbits of similar characteristics when based on comparable arcs. They do not relate to any further specification of the absolute values of the elements, as such do not appear to be lacking.

The observations were taken from Minor Planet Circular 515 and were photographed with the 24-inch reflector of the Yerkes Observatory. The method of computation is that of Laplace, with modifications of Leuschner and Williams.

The observations on which the two orbits were based are as follows:

1. 1947 U.T.	Mean Positions (1950.0) α	δ
I Jan 22.25761	$7^h\ 18^m\ 11^s.26$	$+23^\circ\ 49'\ 49''.7$
II Feb 19.10000	$7^h\ 01^m\ 18^s.88$	$+24^\circ\ 35'\ 44''.3$
III Mar 18.12093	$7^h\ 04^m\ 41^s.56$	$+24^\circ\ 36'\ 54''.1$

2. 1947 U.T.	Mean Positions (1950.0) α	δ
I Jan 22.27289	$7^h\ 18^m\ 10^s.28$	$+23^\circ\ 49'\ 51''.6$
II Feb 19.20625	$7^h\ 01^m\ 17^s.24$	$+24^\circ\ 35'\ 49''.3$
III Mar 18.16111	$7^h\ 04^m\ 42^s.78$	$+24^\circ\ 36'\ 51''.4$

Summary of Elements

T = 1947 Feb 19.08884	T = 1947 Feb 19.19505
L = $112^\circ\ 42'\ 24''$	L = $110^\circ\ 16'\ 29''$
w = $326^\circ\ 14'\ 52''$	w = $313^\circ\ 41'\ 41''$
Ω = $94^\circ\ 22'\ 47''$	Ω = $94^\circ\ 18'\ 19''$
i = $3^\circ\ 17'\ 09''$	i = $3^\circ\ 18'\ 39''$
e = 0.063696	e = 0.078153
ϕ = arc sin e = $3^\circ\ 39'\ 07''$	ϕ = arc sin e = $4^\circ\ 28'\ 57''$
a = 2.877648	a = 2.867893
q = 2.694353	q = 2.643759
n = 726".859	n = 730".571

Range of Solution

T = 0.10621 day	e = 0.014457
L = $2^\circ\ 25'\ 55''$	a = 0.009755
Ω = $00^\circ\ 04'\ 28''$	n = 3".712
i = $00^\circ\ 01'\ 30''$	

Explanation of Symbols

T = Time of Epoch Observation
L = Mean longitude within the orbit
Ω = Heliocentric longitude of ascending node
w = Angle from ascending node to perihelion point
e = Eccentricity of orbit
ϕ = Arc sin e
i = Inclination of orbit plane to ecliptic
a = Major semi-axis of orbit
n = Mean daily motion
k = Gaussian constant

The units of length, mass, and time are respectively the astronomical unit, the mass of the sun, and $\frac{1}{k}$ mean solar days.

1. Astronomische Nachrichten, No. 167, p. 267.
2. Astronomische Nachrichten, No. 206, pp. 51 & 52.
3. Beobachtungs-Zirkuler der Astronomische Nachrichten, No. 35, p. 59.
4. Bulletin of Institute of Theoretical Astronomy, Academy of Sciences, U.S.S.R., Vol. 4, No. 9(62), p. 488.

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MANIFESTATIONS OF OPAQUE AND TRANSLUCENT COLONIAL VARIANTS OF SEVERAL ENTERIC BACTERIA

(Publication No. 4921)

Robert Feinberg, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: W. G. HUTCHINSON

Three strains of E. coli, strains CB-6, 40 and 4, one Shigella alkalescens strain, 14811, and two Salmonella strains, S. enteritidis and S.sp (Type London) were studied by morphological, serological, bacteriophage, biochemical and virulence techniques in reference to their parent opaque and variant translucent colonial forms.

The colonial differences could be detected by either directly or obliquely transmitted light when the organisms were plated on a relatively transparent medium as one per cent tryptone agar. A transition from opaque to opaque-translucent to translucent-opaque to translucent has been proposed to explain the colonial variation.

A mutation rate of 7.5×10^{-2} was found for the opaque to translucent variation based on equilibrium percentages and generation time of the parent and mutant. This rate appears too high to be caused by known genetic mechanisms.

Serological cross reaction between the Shigella culture and the three E. coli cultures was shown to be due to common somatic antigens in the translucent phase. No cross reactions between the opaque cultures was demonstrated.

In studies with bacteriophage of the T series the opaque cultures of CB-6, 40 and 4 were found sensitive to the phage whereas the translucent colonial types were resistant. These three sensitive cultures showed no serological cross reaction with E. coli B and the data seemed to rule out any possible correlation of somatic antigens and bacteriophage sensitivity.

Chromatographic techniques failed to reveal any constitutive differences in amino acids of sugars between the opaque and translucent cultures of the same strain.

In some cases aerogenesis and anaerogenisis was shown to be associated with the opaque and translucent colonies respectively. Methylene blue reduction techniques showed the presence of the enzymes formic dehydrogenase and hydrogenase in both opaque and translucent cultures. This would suggest that either a third enzyme (formic hydrogenlyase), an iron carrier system or some other factor is lacking in the anaerogenic (translucent) culture which is unable to produce gas from formate.

Whenever variants in pathogenic organisms are found the question arises as to which strain is the most virulent. In the case of Salmonella enteritidis the opaque proved to be most virulent for mice, a situation analogous to that found in Salmonella typhosa. When Shigella alkalescens was the test organism the translucent type was more virulent, analogous to the results found for Salmonella typhmurium.

The relationship between the present work and the literature was discussed.

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A STUDY OF MICROBIAL ACTIVITIES IN THE OVINE RUMEN

(Publication No. 4702)

William Goff Walter, Ph.D.
Michigan State College, 1952

A manometric method employing a constant volume Warburg apparatus has been used in evaluating the fermentation activity in vitro of ingesta from sheep with permanent rumen fistulas at various intervals after eating different rations.

A basal fermentation was determined by measuring the gas produced when mixtures of rumen ingesta and bicarbonate or phosphate buffer were allowed to react under anaerobic conditions at 37 C. Glucose and other fermentations were investigated when an excess of substrate was added.

The glucose fermentation exceeded the basal by 10 to 20 times with samples obtained 12 to 15 hours after eating. Shortly after consuming hay and water, the basal rate increased and glucose fermentation decreased. As the period following eating lengthened, the basal rate dropped and the glucose rate rose.

Sucrose fermentation exceeded slightly the activity on glucose. Glucose fermentation was 2 to several times greater than D-xylose, hemicellulose, soluble starch and corn starch, although this varied with the time after eating.

When barley supplemented the alfalfa diet, an increase in the fermentation of all substrates was noted although there was no appreciable change in the number of bacteria counted in the rumen fluid by direct microscopy employing a diluted carbol fuchsin stain. The pH of all samples was lower with barley in the diet, dropping to about 6.0 shortly after eating.

An oat straw diet for 15 days resulted in little change in the basal rate of samples collected 12 to 15 hours after eating, but a decrease in the fermentation of glucose, corn starch, ground barley and alfalfa substrates was noted. When corn starch was added to the rumen for 9 days, there was some increase in the fermentation of the substrates but not the basal. The number of organisms declined from about 30 billion bacteria per ml on an alfalfa diet to about 10 billion per ml on the straw-starch ration.

Phosphate and bicarbonate were employed as buffers in the Warburg flasks. In general, greater

volumes of gas were recorded with the bicarbonate.

One ml of rumen ingesta treated with acid released about 1600, 800, and 1300 ul CO_2 when obtained 15, 1, and 6 hours respectively after eating. The amount of bicarbonate in the anterior and posterior of the rumen varied with the time in which the saliva had been mixed with the ingesta.

The initial and residual bicarbonates determined in the flasks with early morning samples were about twice as great with the bicarbonate buffer as with the phosphate. These values varied at different times of the day. Without exception, the glucose fermentation and acid CO_2 were higher with the bicarbonate buffer. However, there was no consistent difference between the metabolic CO_2 values.

The fermentation capacity of a 6-year-old sheep with an open fistula was about 50 percent less than that of a 3-year-old ewe with a fistula closed by a lucite plug. The average number of bacteria in the rumen fluid for 12 consecutive days on an alfalfa diet were 18.5 billion for the sheep with the open fistula and 22.6 billion bacteria per ml for the other.

The numbers of bacteria per ml of ingesta from 2 ewes under a variety of conditions over a period of 2 years were between 5 and 50 billion with an average of about 30 billion. In general the counts showed little correlation with the fermentation capacity of the ingesta.

The manometric method warrants further investigation for possible uses in evaluating rations, in determining the effects of therapeutic agents on the rumen microflora, and in obtaining additional information on ruminant digestion.

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THE CYTOLOGY OF MITOCHONDRIA AND NUCLEI IN MYCOBACTERIA

(Publication No. 4958)

Loren C. Winterscheid, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: STUART MUDD

In living cells of the tubercle bacillus examined in an unstained wet mount with the light microscope, brightly refractile granules - mitochondria - may be seen in the cytoplasm. Using the phase-contrast microscope, these brightly refractile granules appear dark and dense in a clear cytoplasm. In addition, a less distinct, irregular central area - nucleus -, denser than the cytoplasm, may be seen.

Mycobacterium thamnopheos and Mycobacterium tuberculosis var. hominis were used in these studies. Certain of the properties of the mitochondrial granules were demonstrated by the use of cytochemical indicators such as the tetrazoles, Janus Green B, the Nadi reagent, Baker's phospholipid stain, and Harman's mitochondrial stain. The identification of the irregular central areas as nuclei is based on their positive Feulgen reaction and their strong staining with the DeLamater nuclear stain.

The reduction of the tetrazoles, triphenyl tetrazolium chloride (TTC) and neotetrazolium chloride (NTC), to their colored formazans is mediated by a DPN-linked flavoprotein, cytochrome c reductase. Riboflavin is concentrated in mitochondria to a considerable extent, a finding indicating the probable presence of flavoproteins. In living tubercle bacilli on direct observation and in fixed and stained preparations the reduced tetrazoles are found in association with the mitochondrial granules.

The bulk of cellular cytochrome oxidase is found in mitochondria. The Nadi reaction is a specific indicator of this compound and the vital staining of mitochondria with Janus Green B depends on its presence. Both of these cytochemical indicators stain only the mitochondrial granules in Mycobacteria. Concomitant staining with TTC and Janus Green B demonstrates that both stain the same sites in tubercle bacilli - the mitochondria.

Mitochondria contain 25-30 percent lipids by dry weight of which one-half to two-thirds is present as phospholipids. Baker's stain is a specific stain fc · phospholipids. The tubercle bacilli as shown by this procedure have phospholipids throughout the cell with high concentrations in the mitochondrial granules.

Harman's stain, an empirically specific stain for mitochondria, stains only the mitochondrial granules in tubercle bacilli.

The irregular central areas of the tubercle bacilli, as seen with the phase-contrast microscope, are stained by the Feulgen nucleal reaction and the DeLamater nuclear stain. These two nuclear procedures do not stain the mitochondrial granules. Indeed, using NTC or TTC and the Feulgen or DeLamater nuclear stains, respectively, on the same cells, one may differentiate clearly and specifically the mitochondria and the nuclei.

Both structures may be beautifully demonstrated by using dilute methylene blue. Solutions of this dye may contain monomers, dimers, and polymers of the dye molecule. It is characteristic of nucleic acids to be stained blue by the monomer and/or the dimer. Just as characteristically the polymers do not stain nucleic acids but do stain metaphosphates reddish-violet. In tubercle bacilli stained with this dye the nuclei appear dark blue, the cytoplasm light blue and the mitochondria reddish-violet.

Electron microscopy of these cells reveals exceedingly electronopaque objects in a clear cytoplasm. These correspond to the mitochondrial granules. The contours of these granules have minimal areas and can be deformed by contiguous structures. They volatilize under intense electron bombardment leaving torn and distorted membranes. This volatilization is characteristic of high metaphosphate content. The nuclei are not well visualized in tubercle bacilli due to the remarkable cytoplasmic transparency which allows no contrast for structures that are also electron transparent. However, a suggestion of nuclear structures as well as the dense, elliptical, obvious

mitochondria are visualized in virulent human tubercle bacilli where the cytoplasm is less electron transparent.

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BIOLOGY

BIOLOGY, GENETICS

INHERITANCE OF REACTION TO BUNT IN CROSSES INVOLVING REDMAN WHEAT AND SOME OF ITS ANCESTORS

(Publication No. 4856)

Alvin Edmund Hannah, Ph.D.
University of Minnesota, 1952

Studies of inheritance of reaction to one collection of bunt, identified as Physiologic Race 1 of Tilletia foetida, were made in crosses of Redman, its parental varieties (Regent and Canus), and one grandparent, Reward. The crosses were made in all combinations except reciprocals. In addition, certain selected lines from these crosses were tested in F_4 to two additional races of bunt, Race 2 of Tilletia caries (D.D.) Tul. and a virulent race of Tilletia foetida (Wallr.) Liro, designated as T.F. 48-7.

The F_1, F_2 and backcross data were used to obtain an estimate of the number and the degree of effectiveness of the genes segregating in the different crosses. A comprehensive hypothesis was then formulated for all crosses and tested by comparing theoretical and observed values over the complete set of crosses.

A percentage infection value, based on assumptions of gene values and gene action, was assigned to each genotype involved in the cross. A mean percentage infection value, based on the assigned genotypic infection values, was calculated for each genotypically different F_3 line. The same assigned gene values were used for all crosses where applicable. The calculated frequency distributions for each genotypic class were determined by use of the mean percentage infection values, standard errors and normal curve areas.

Canus, Redman and Regent were classified as resistant to Race 1 of Tilletia foetida and Reward as susceptible. Regent and Canus are the immediate parents of Redman. Reward and H-44 are the parents of Regent. The resistant x resistant cross of Regent x Canus segregated susceptible lines indicating that the Regent and Canus genes conditioning bunt resistance are different. The resistant x resistant crosses (Redman x Canus and Redman x Regent) did not segregate susceptible lines indicating that Redman has received genes conditioning bunt resistance from both the Regent and Canus parents. Under the conditions of this experiment the Canus genes gave a more complete resistance to Race 1 of Tilletia foetida than did the Regent genes.

The data from resistant x susceptible crosses indicated that Canus carried an incompletely recessive major gene and a minor dominant gene which conditioned resistance to Race 1 of Tilletia foetida. The effect of the minor gene was masked in the presence of the homozygous major recessive gene. Regent differed from the susceptible parent by multiple genes, possibly three gene pairs. None of these gene pairs reduced the infection percentage very much, but a combination of all three pairs reduced the infection percentage to 3.8 under the conditions of this experiment. Redman appears to have received one gene (a) for resistance to bunt from the Canus parent and two genes (B and C) from the Regent parent, therefore, it would also differ from the susceptible parent by three gene pairs. A combination of the Canus gene and the Regent genes, carried by Redman, reduced the infection percentage to 0.5 under the conditions of this experiment. The Reward genotype was assumed to be completely susceptible.

Tests of selected F_4 lines to two additional races of bunt indicated that either the Canus or Regent genes gave effective resistance to Race 2 of Tilletia caries but gave only partial resistance to the virulent race Tilletia foetida 48-7. Certain lines combining the Regent and Canus genes appeared to give effective resistance, under the conditions of this experiment, to the races of bunt used in this study. Therefore, the Redman genotype should have effective resistance to all three races of bunt used in this study. The number of lines tested from each cross was too small to determine the exact number of genes, or the identity of the genes, conditioning resistance to these races.

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INHERITANCE OF THE MODE OF REACTION TO STEM RUST, PARTICULARLY RACE 15B, AND LEAF RUST IN TWO CROSSES OF VULGARE WHEATS

(Publication No. 4861)

Guy Langston Jones, Ph.D.
University of Minnesota, 1952

The epidemic in 1950 of black stem rust of wheat, Puccinia graminis tritici Erikss. & Henn. was caused primarily by race 15B. None of the commercially-

grown wheat varieties were resistant to race 15B; however, breeding for resistance to this race of rust was already in progress prior to 1950. The present study was undertaken primarily to determine the mode of inheritance of field and seedling reaction to certain stem rust races, with particular reference to race 15B. Reaction to leaf rust was also studied in the field and seedling stages.

Two of the parents, II-44-22 and II-44-29, were selections from crosses of Mida x Kenya 117A and Kenya 58 x Newthatch, respectively, and were resistant to stem rust race 15B at all temperatures in the greenhouse and a collection of races in the field, and susceptible to leaf rust. Frontana, the common parent in the two crosses was moderately susceptible to stem rust race 15B and resistant to a large number of races of leaf rust.

Inheritance of seedling reaction to stem rust race 15B was studied in the F_2 and F_4 generations in the greenhouse at high temperatures (85°F.). Seedling reaction of the same F_4 bulked lines to stem rust races 11, 17, 36, 38, and 56 and leaf rust races 5 and 15 were also studied. The greenhouse stem rust studies of F_4 bulked lines were made under high temperatures with supplemental light. Stem and leaf rust reaction in the field to a collection of races were studied in the F_3 generation.

On the basis of F_2 results in the greenhouse, seedling reaction to the "Abercrombie" isolate of stem rust race 15B appeared to be controlled by a single gene, but seedling studies in the F_4 generation indicated that the inheritance was more complex.

Three separate tests of the seedling reactions of the same random F_4 bulked lines of each of the crosses to the "Abercrombie" isolate of stem rust race 15B were made in the greenhouse. There were differences in the reactions of lines between the separate runs and differences in the number of hours of sunlight occurring during each run. It appeared that as the number of hours of sunlight increased the number of plants or lines showing the resistant type pustule increased and the number showing susceptibility decreased. The seedling reaction to race 15B of the Kenya derivative-parents and progenies of their crosses with Frontana was greatly influenced by light and temperature. Seedling resistance was conditioned by three independent genes in both the crosses; however, there were different gene interactions in each cross.

In studies of the seedling reaction to a mixture of cultures of stem rust race 15B, some biotypes appeared to be more pathogenic than the "Abercrombie" isolate alone.

Seedling reaction to each of the other races of stem rust, 11, 17, 36, 38, and 56, and to the races of leaf rust; 5 and 15, appeared to be simply inherited. It seemed that the leaf rust resistance of Frontana could be combined with both seedling resistance to certain races, including 15B, of stem rust and field resistance to a collection of races of stem rust.

Leaf tip necrosis was associated with reaction to stem rust race 15B and the resistance of the Kenya derivatives under high temperature and high light conditions. Browning reaction was associated with the rust reaction of certain hosts to stem rust races 11 and 56 when grown under conditions of high temperatures and high light intensities.

Awnedness was inherited on a monogenic basis in the cross Frontana x II-44-29. It was not associated with the other characters studied.

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THE EFFECT OF OXYGEN CONCENTRATION ON THE INDUCTION OF LETHALITY AND CHROMOSOMAL ABERRATIONS BY X-RAYS IN HABROBRACON AND SCIARA.

(Publication No. 4939)

Walter Kenworthy, Ph. D.
University of Pennsylvania, 1953

SUPERVISOR: CHARLES W. METZ

Irradiation in the absence of oxygen has been found by many investigators to decrease the amount of nuclear damage caused by x-rays. The present study was undertaken to see whether such a decrease in x-ray effects was related to the meiotic stage during which irradiation took place.

Survival ratios were determined for 3,998 Habrobracon eggs x-rayed during meiotic metaphase I in oxygen, air, or nitrogen. Survival of eggs irradiated in nitrogen ranged from 64.6% at 506 r to 10.6% at 2,200 r. Survival of eggs irradiated in air ranged from 36.3% at 506 r to no survivors at 2,200 r (1.9% survived at 1,518 r). Survival of eggs irradiated in oxygen ranged from 27.5% at 506 r to no survivors at doses of 1,518 r and above (2.6% survived at 1,100 r).

Survival ratios were determined for 1,622 Habrobracon eggs irradiated during meiotic prophase in oxygen or nitrogen. Survival of eggs irradiated in nitrogen ranged from 92.7% at 1,700 r to 20.0% at 24,000 r. Survival of eggs irradiated in oxygen ranged from 70.7% at 1,700 r to 1.6% at 24,000 r.

Dose-action survival curves for eggs irradiated in metaphase appeared to be of the exponential type regardless of the gas in which irradiation took place. Dose-action curves for eggs irradiated in prophase appeared to be linear for the x-ray doses given.

Preliminary results from cytological studies of eggs irradiated with approximately 1,000 r during meiotic metaphase I showed no chromosomal abnormalities other than those resulting from terminal deletions. The percentage of such abnormalities was lower in eggs irradiated in nitrogen than in those irradiated in air or oxygen. Comparisons of observed chromosomal damage with survival data suggest that both dominant and recessive lethals decrease when irradiation takes place in the absence of oxygen.

Irradiation of Sciara males in oxygen, air, and nitrogen followed by examination of the salivary gland chromosomes of their offspring for abnormalities showed that the same type of rearrangement (reciprocal translocations) was induced at different oxygen concentrations. It appears likely that fewer

aberrations are induced when irradiation takes place in the absence of oxygen.

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SOME ASPECTS OF CHEMICAL MUTAGENESIS IN HABROBRACON JUGLANDIS ASHMEAD AND SCIARA COPROPHILA LINTNER

(Publication No. 4953)

Robert Carsten von Borstel, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: C. W. METZ

This study was undertaken to examine the nature of chemical mutagenesis in two organisms in which certain aspects of the mutagenic action of x-rays have been well-described.

Habrobracon juglandis Ashmead and Sciara coprophila Lintner were selected as test organisms — Habrobracon for obtaining genetic and cytological information on meiotic stage sensitivity, and Sciara for a refined study of salivary gland chromosomes following treatment at different stages of the meiotic cycle.

The principal chemical selected for the mutagenic studies was nitrogen mustard. These studies were supplemented by some observations on the effects produced by three other possible mutagens and a polyploidy-inducing agent. The chemicals were t-butyl hydroperoxide, di-t-butyl peroxide, and t-butyl peracetate, and the polyploidy-inducing agent, colchicine.

The apparatus used in this study for generating aerosols of the mutagens was an accurate device for testing the mutagenic action of nitrogen mustard. The results were repeatable and dose-hatchability data were consistent in both Habrobracon and Sciara.

It was indicated that nitrogen mustard induced true dominant lethal mutations in Habrobracon oocytes and sperm: (1) At least 88% of the eggs examined in first cleavage, after a lethal dose, possessed chromosomal alterations; (2) treatment of eggs or sperm resulted in apparently identical nuclear effects, and, for the most part, lethality induced in one of the gametes was dominant over the normal gamete; and (3) the effects induced in gametes were not transitory and did not diminish with time.

Dominant lethality induced in Habrobracon gametes by nitrogen mustard was apparently caused by action of the mutagen on the nucleus.

Inactivation of Habrobracon sperm following exposure to nitrogen mustard was established as a phenomenon differing distinctly from induced dominant lethality.

When Habrobracon wasps were mated immediately after treatment, the nitrogen mustard induced lethality in the gametes of the untreated sex.

Comparison of the effects of nitrogen mustard with those of x-rays (for x-ray studies on Habrobracon see Whiting, 1945 a and b; for x-ray studies on Sciara see Bozeman and Metz, 1949) reveals that the agents were both similar and dissimilar in action. The similar effect was that the first meiotic metaphase (Habrobracon) and anaphase (Sciara) were more sensitive to mutagens than was the first meiotic prophase. Several dissimilar effects were noted: (1) Nitrogen mustard induces breaks which were interpreted as being predominantly single chromatid, whereas x-rays predominantly induce isochromatid breaks (Habrobracon); (2) the induced chromosome aberration frequency in Sciara, as far as gross rearrangements are concerned, was apparently much less with nitrogen mustard than with x-rays; and (3) following nitrogen mustard treatment of Habrobracon gametes, death from induced lethality occurred at a specific stage (the sixth or seventh cleavage), whereas the state in development when death occurred from x-ray induced lethality was less specific.

Concurrent with death at the sixth or seventh cleavage from exposure of Habrobracon oocytes or sperm to nitrogen mustard was a swelling of the nuclei. The nuclei occasionally enlarged to about 200 times their normal volume. Nucleoli also enlarged and were highly refractive.

Under the conditions of the experiments, the organic peroxides proved to be non-mutagenic in Habrobracon and Sciara, and colchicine failed to induce diploidy in haploid Habrobracon eggs.

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RESPIRATORY STUDIES ON LEAVES OF HIGHER PLANTS

(Publication No. 4851)

Joseph Michael Daly, Ph.D.
University of Minnesota, 1952

The role of cytochrome oxidase in the respiration of leaves of higher plants has not been adequately evaluated previously because of the technical difficulties involved. The most reliable criterion for the participation of this enzyme in respiration consists in determining if oxygen uptake in vivo is inhibited by carbon monoxide and, to differentiate this enzyme from other oxidases, to establish that the inhibition is reversed by light. In manometric studies on leaves, however, this procedure can not be followed because light causes the production of oxygen by photosynthesis at rates which completely mask respiratory uptake of oxygen. It is possible to circumvent this problem by using tracer oxygen (mass 34) to determine respiratory uptake in the light, since only oxygen of mass 32 is produced during photosynthesis.

It was necessary first to determine the degree of inhibition of respiration by carbon monoxide in leaves, and it was found that the effects of carbon monoxide were not consistent. In wild plum (Prunus americana) stimulation of gas uptake rather than inhibition was observed. This was shown to be respiratory stimulation by carbon monoxide rather than oxidation of carbon monoxide to carbon dioxide as has been reported for animal tissues. This suggests that in wild plum carbon monoxide affects other respiratory enzymes in addition to the oxidases. Similar results were obtained in other genera.

In flowering tobacco (Nicotiana affinis) the effect of the inhibitor is not consistent from test to test. It was established by other means that cytochrome oxidase was present, even though inhibition with carbon monoxide was obtained irregularly. The observed discrepancy does not reside in procedural errors, but is dependent in some manner on the metabolic state of the leaf, since environmental conditions affect the results.

In barley (Hordeum vulgare), carbon monoxide inhibition declines with age. This is shown not to result from destruction of respiratory enzymes or lack of substrate, but from the existence of unknown metabolic controls. Experiments with sodium azide and dinitrophenol indicated that the phosphate cycle was responsible, but the rapid oxidation of added sugar and citric acid does not support this view. Regardless of the nature of the control, it is possible to increase respiration in mature leaves and show that the oxidases involved are sensitive to carbon monoxide. Similar results were obtained with carrot (Daucus carota) and spinach (Spinicia oleracea and Tetragonia expansa).

In young leaves of barley, spinach, and carrot, it is possible to demonstrate that cytochrome oxidase participates in respiration in vivo by light reversal of carbon monoxide inhibition using tracer oxygen to measure respiration in the light.

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STUDIES ON SPECIALIZATION AND PATHOGENICITY IN PUCCINIA CORONATA CORDA 1/

(Publication No. 4872)

Bjorn Peturson, Ph.D.
University of Minnesota, 1952

Investigations were carried out at the Dominion Laboratory of Plant Pathology, Winnipeg, Manitoba, Canada, to determine (1) the varieties of Puccinia coronata occurring on Rhamnus cathartica in Canada, (2) extent of specialization in Puccinia coronata var. avenae and (3) pathogenic effects of the var. avenae on oat varieties.

Three distinct varieties of Puccinia coronata were isolated, namely, avenae, festucae, and a variety that had not previously been reported elsewhere. The designation P. coronata var. secalis is here proposed for this new variety owing to its ability to infect many varieties of cultivated rye. This variety is also pathogenic to species of Agropyron, Bromus, Elymus and Hordeum. However, all oat varieties tested proved to be immune from it. The var. secalis differed from the other two varieties studied in host range and other respects. The apical processes of its teliospores are much longer than those of teliospores of varieties avenae and festucae and its urediospores are very noticeably darker in color than those of var. avenae and var. festucae. The varieties avenae, secalis and festucae comprised 60.6 percent, 36.6 percent and 2.8 percent, respectively, of 71 isolates originating from aecial infections on Rhamnus cathartica in Eastern Canada. In Manitoba the variety secalis was more prevalent on R. cathartica than the var. avenae. The var. festucae was not found there.

Surveys were made yearly throughout Canada from 1935 to 1950 to determine the prevalence and distribution of races of crown rust. With the aid of thirteen standard differential hosts used in Canada and the United States for race identification, and the varieties Mutica Ukraine C.I. 3259, and Saia C.I. 4659, twenty-six races and biotypes of crown rust were identified from 2,186 isolates studied. Races 1, 2, 3, 4, 5 and 6 were the predominant ones from 1935 to 1948. In 1946, races that attack Bond (34, 45 and 57) began to increase significantly and in 1950 they were the predominant ones in Canada. No race was confined to any one area. All the common races were widespread. Some races were more

prevalent in certain areas. This applied particularly to races 2 and 3, which were predominant in Eastern Canada. None of the races and biotypes isolated was pathogenic to the four varieties (Landhafer, Santa Fe, Trispernia and Victoria) now used for breeding for crown rust resistance. The host reactions of some of the differential varieties were affected by temperature, and race identifications were, therefore, made at controlled temperatures ranging from 65° to 70° F.

Crown-rust infections adversely affected the yield, quality, test weight, grade and protein content of the seed of oat varieties. The amount of damage caused was roughly proportional to the severity of infection present. In general, light infections caused only minor reductions in yield and quality, while heavy infections caused very substantial reductions. Infections ranging from 68 to 80 percent caused yield reductions ranging from 19.2 to 27.8 percent; kernel weight reduction ranging from 12.3 to 16.1 percent; bushel weight reductions ranging from 2.7 to 6.7 pounds; and grade reductions averaging about one grade. A 90 percent infection on Anthony oats reduced its yield 81.2 percent; its kernel weight 32.7 percent; its bushel weight 14 pounds; and its grade several grades. Moderate to heavy infections caused statistically significant reductions in the percentage of the protein of the seed of oat varieties. The reductions in protein of the seed ranged from 0.74 to 1.24 percent. Rust infection had no effect on the fat content of the seed.

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CHEMISTRY

CHEMISTRY, GENERAL

THE CALORIMETRIC DETERMINATION OF THE ADSORPTION ENERGY OF GASES ON SOLID SURFACES

(Publication No. 4844)

Robert A. Brand, Ph.D.
University of Minnesota, 1952

The adsorption isotherm was determined gravimetrically for the system Bromine on silica gel at 28.9°C. and found to give a type II isotherm in contrast to the type III isotherms previously reported for the same system at higher temperatures. The data for this system gives poor agreement with the BET theory even in the region where BET theory usually gives good agreement.

The calorimetric determination of the heat of adsorption of the same system shows a decrease with increased surface coverage. The value of the heat of adsorption varies from 10,000 calories per mole at the lowest relative pressures to a value of 8,600 calories per mole at one-tenth of the saturation pressure. This is considerably above the heat of liquifaction, 7,520 calories per mole, which is the value predicted by the BET theory for the heat adsorption of the first layer. The variation in the heat of adsorption is also greater than that predicted by the BET theory and the variation is attributed to surface heterogeneity.

The partial molal entropy of the adsorbed phase was calculated and found to be the same as the molar entropy of the liquid at the same temperature within the experimental error. This is compared with the calculations of other investigators where the entropy of the adsorbed phase at lower temperatures was found to be below that of the liquid until the surface coverage reached that of a monolayer. The higher value of the entropy of the adsorbed phase relative to the liquid for the present investigation shows a greater number of degrees of freedom for the adsorbed phase. This shows the need for a better model of the adsorbed phase than that offered by the BET theory.

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THE SYNTHESIS OF SOME DERIVATIVES OF SACCHARIN

(Publication No. 4855)

Glenn Herbert Hamor, Ph.D.
University of Minnesota, 1952

The main object of this research was the synthesis of some 2-alkyl and 2-dialkylaminoalkyl derivatives of saccharin. Also included in the investigation were the corresponding saccharin derivatives containing amino groups substituted in the 5- and in the 6-positions.

Because these compounds can be considered to be "ammono" analogs of the benzoic acid esters which are active local anesthetics, it was thought that the resultant compounds might also possess local anesthetic properties.

1. By the reaction of sodium saccharin with the alkyl or dialkylaminoalkyl halide, saccharin derivatives containing the following groups substituted in the 2-position were prepared and characterized.
   a. $-CH_2CH_3$
   b. $-CH_2CH_2CH_3$

c. $-CH_2CH=CH_2$
d. $-(CH_2)_4CH_3$
e. $-CH_2CH_2N(CH_3)_2.HCl$
f. $-CH_2CH_2N(C_2H_5)_2.HCl$
g. $-CH_2CH_2N(n\text{-}C_4H_9)_2.\ HCl$
h. $-CH_2CH_2CH_2N(C_2H_5)_2.HCl$

2. 6-Nitrosaccharin was synthesized by the alkaline potassium permanganate oxidation of 4-nitrotoluene-2-sulfonamide. The sulfonamide was prepared from sodium 4-nitrotoluene-2-sulfonate by conversion to the acid chloride with phosphorus pentachloride and then by the action of ammonia to the final product.

As in the saccharin series the alkyl derivatives of 6-nitrosaccharin that were made were the 2-ethyl, 2-n-propyl, 2-allyl, and 2-n-amyl compounds. The synthesis of the 2-dialkylaminoalkyl derivatives of 6-nitrosaccharin corresponding to those prepared in the saccharin series resulted in compounds which were oils or, if solid, were compounds in which the analytical values obtained did not agree with those calculated for the desired compound.

3. The 2-ethyl, 2-n-propyl and 2-allyl derivatives of 6-aminosaccharin were prepared by reduction of the corresponding 6-nitrosaccharins.

4. The next phase of the problem was concerned with the preparation of derivatives of 5-aminosaccharin. Because Stubbs had reported obtaining 5-nitrosaccharin from the nitro-o-sulfobenzoic acid prepared by the nitration of o-sulfobenzoic acid, an investigation of this nitration reaction was carried out.

The nitration gave a mixture of nitrated o-sulfobenzoic acids which was obtained as the barium salt. This mixture of barium salts could not be separated by fractional crystallization. By conversion of the barium nitro-o-sulfobenzoates to the diacid chlorides and then by action of ammonia, the mixed nitrosaccharins were obtained. Two different nitrosaccharins were isolated from the mixture.

a. One was a bitter tasting compound melting at 206-206.5°C. This compound was shown to be 6-nitrosaccharin by the fact that a mixed melting point of it with the 6-nitrosaccharin prepared previously showed no depression.

b. The other nitrosaccharin was a sweet tasting compound melting at 227-228°C. and could be any one of three: the 4-, 5- or 7-nitrosaccharins. In order to build up evidence for identifying the compound, several derivatives of this unidentified nitrosaccharin were prepared.

(1.) (?)-Aminosaccharin and (?)-acetylaminosaccharin were synthesized. The (?)-acetylaminosaccharin melted at 332-333°C. (decomp.) as compared with a melting point of 299°C. reported by Backeberg and Marais for the 5-acetylaminosaccharin prepared by another route. This suggests that the acetylaminosaccharin prepared in this thesis is not identical with the 5-acetylaminosaccharin of Backeberg and Marais.

(2.) The 2-ethyl and 2-n-propyl derivatives of this unidentified nitrosaccharin were synthesized.

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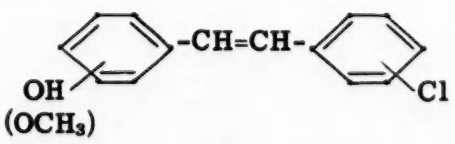
SYNTHESES OF 2(3,4)-HYDROXY-(AND METHOXY)-2'(3',4')-CHLORO-STILBENES AND -BIBENZYLS

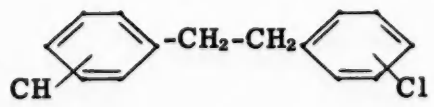
(Publication No. 4710)

Robert Joseph Hathaway, Ph.D.
Michigan State College, 1951

The syntheses of the isomeric hydroxy- and methoxychlorostilbenes (I) and the corresponding hydroxybibenzyls (II) have been investigated. Incidental to their preparation, the methoxyphenylchlorobenzyl carbinols (III) have also been prepared.



I.



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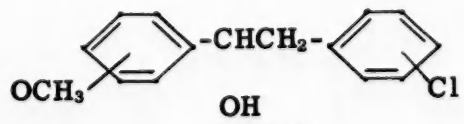

III.

Thirty-six compounds, excluding derivatives, have been synthesized and the majority submitted for pharmacological testing. Six of these compounds have been reported in the literature.

The method of attack which appeared most suitable was to prepare substituted stilbenes of type I and reduce them catalytically to bibenzyls of type II, as there were several examples reported in the literature for the reduction of chlorostilbenes to chlorobibenzyls (1).

Among the methods of synthesis investigated for the preparation of the stilbenes were (a) the Meerwein reaction; (b) conversion of mixed benzoins into the stilbenes by simultaneous reduction-dehydration- and (c) the Grignard reaction. Of these methods, the latter proved to be the most satisfactory for general use.

The Meerwein reaction (2) appeared most promising inasmuch as 4-hydroxy-4'- chlorostilbene was reportedly obtained in 56% yield by Meerwein et. al. However, the yields of this same compound in the present investigation were considerably lower and averaged 22%. The application of this reaction for the preparation of three other isomers proved unsatisfactory and its use was abandoned.

A second method was the attempted conversion of mixed benzoins (3) by simultaneous reduction-dehydration using zinc and hydrochloric acid, into the stilbenes (4). The yields in the latter step were so low that the method was abandoned.

The Grignard reaction (5) between the methoxybenzaldehydes and chlorobenzylmagnesium chlorides gave the corresponding methoxyphenylchlorobenzyl carbinols (III) in good yield. It was found possible to dehydrate these carbinols to the methoxystilbenes (I), but the conversion of the latter to the hydroxystilbenes proved difficult at first; normally used methods gave low yields of the desired product. However, after finding the excellent demethylation procedure of Buu-Hoi and Hoan (6) using pyridine hydrochloride at about 200°, not only was it possible to demethylate the methoxystilbenes in good yield, but also to demethylate and dehydrate the carbinols in one step to give the hydroxystilbenes.

Reduction of the stilbenes to the bibenzyls proceeded rather difficultly. Either W-2 Raney nickel (7) or copper chromium oxide gave in the neighborhood of 50% yields when used at 50-70° with hydrogen pressures of 1000-1500 p.s.i.

The p-chlorobenzoyl derivatives of the bibenzyls were prepared using p-chlorobenzoyl chloride. The interconversion between methoxy- and hydroxystilbenes, and the ready dehydration of the carbinols to either of the above two types of compounds, made it unnecessary to prepare derivatives of these compounds.

All the compounds were analyzed for chloride as follows. The compounds were fused with sodium peroxide, the chloride precipitated with excess standard silver nitrate solution, and the excess silver titrated with standard thiocyanate solution.

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THE SYNTHESIS OF SOME N-ALKYL-p-AMIDINO-BENZAMIDES

(Publication No. 4867)

Robert Herman Miller, Ph.D.
University of Minnesota, 1952

p-Cyanobenzoic acid was required in large quantities in this laboratory for several studies. Among these was the preparation of esters of p-carboxybenzamidines and related compounds as potential therapeutic agents. The existing methods in the literature for the preparation of p-cyanobenzoic acid were tried and found to be generally unsatisfactory. Poor and often inconsistent results were obtained. The crude product was badly contaminated and required extensive purification.

A study of the reactions involved in this Sandmeyer Synthesis indicated that the conditions employed in the diazotization step were well suited to the coupling of the newly formed diazonium ion with the excess available amine resulting in the production of the corresponding and undesirable diazoamino compound. This compound crystallizes well, is easily obtained as the sodium salt and can be mistakenly considered as sodium p-cyanobenzoate.

This objectionable condition was avoided by reversing the usual procedure in the diazotization step. An aqueous solution of equivalent amounts of sodium p-cyanobenzoate and sodium nitrite was dripped into or introduced under the surface of a cold mixture of ice, water and four equivalents of hydrochloric acid. When this inverted procedure is applied, the diazotization reaction yielding p-carboxybenzene diazonium chloride is almost quantitative. This modification eliminates the major difficulty in the synthesis of p-cyanobenzoic acid. There is, however, an additional problem involved in the subsequent reaction between p-carboxybenzene diazonium chloride and the alkaline sodium or potassium cuprous cyanide. This is the formation of some undesirable stable isomeric complex of the diazo-cyanide. This side reaction was reduced by suitable temperature control of the reaction mixture. Subsequent decomposition, collection as the sodium salt, acidification, extraction and crystallization of the p-cyanobenzoic acid from hot water gave a product that was free from contaminants and melted sharply at 220°C.

p-Cyanobenzoyl chloride was prepared in excellent yields in the usual manner by treating p-cyanobenzoic acid with thionyl chloride.

Most of the N-alkyl-p-cyanobenzamides were prepared by reacting one equivalent of p-cyanobenzoyl chloride with two equivalents of the primary amine in a non-polar solvent. The yields were excellent and good working directions are suggested for preparing them. The hydrogen and N-methyl derivatives were obtained with a significant decrease in yield when the reaction was conducted in an aqueous medium.

In addition to the known simple unsubstituted amide the following new N-alkyl-p-cyanobenzamides were prepared: methyl, ethyl, n-propyl, iso-propyl, n-butyl, iso-butyl, sec-butyl, tert.-butyl, n-amyl,

iso-amyl, n-hexyl, cyclo-hexyl, 1,3-dimethylbutyl, n-heptyl, n-octyl, 1-methylheptyl, 2-ethylhexyl, and tert-octyl.

The N-alkyl-p-cyanobenzamides were converted under anhydrous conditions to the corresponding imidic esters by suitable modification of the general method of Pinner. A cold dioxane solution of the N-alkyl-p-cyanobenzamide containing ten equivalents of ethanol was treated with anhydrous hydrogen chloride and refrigerated for seven days. Subsequent purification by washing with anhydrous ethyl ether and petroleum ether led to the desired N-alkyl-p-carbethoxy-benzamides in practically quantitative yields. These intermediate imidic esters were further purified by storage in a desiccator over "Drierite" and solid potassium hydroxide pellets at 50 mm. of pressure for forty-eight hours to facilitate the removal of excess hydrogen chloride. Following this treatment the imidic ester hydrochlorides showed no marked affinity for moisture and appeared to be stable for relatively long periods of time. Nineteen N-alkyl-p-carbethoxybenzamides corresponding to the above N-alkyl-p-cyano-benzamides were conveniently prepared by this procedure.

The final N-alkyl-p-amidinobenzamides were prepared by heating an ammoniacal alcoholic solution of the imidic ester hydrochloride until it gave a definite acidic reaction. Concentration and subsequent crystallization from an alcohol-acetone-ether mixture produced p-amidinobenzamide and the N-alkyl-p-amidinobenzamides corresponding to the above mentioned N-alkyl-p-cyanobenzamides.

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A SYNTHESIS OF PSEUDOPELLETIERINE

(Publication No. 4873)

Blake F. Putney, Ph.D.
University of Minnesota, 1952

A new synthesis of pseudopelletierine ($C_9H_{15}NO$) has been accomplished in which the diethyl ester of lobelinic acid ($C_{14}H_{25}NO_4$) was subjected to an inner acetoacetic ester condensation to yield carbethoxy pseudopelletierine which on hydrolysis and decarboxylation gave pseudopelletierine. The pseudopelletierine was obtained in a 50% yield from diethyl lobelinate and was identified by comparison of the compound itself and two of its derivatives with a known sample of pseudopelletierine.

The lobelinic acid used in this synthesis was prepared starting with 2,6-lutidine (C_7H_9N), which was reacted with benzaldehyde to give 2,6-distyrylpyridine ($C_{21}H_{17}N$). The latter compound on bromination and dehydrobromination gave 2,6-di-(β-phenylethinyl) pyridine ($C_{21}H_{13}N$), which on hydration with 50% sulfuric acid gave 2,6-diphenacylpyridine ($C_{21}H_{17}NO_2$). The 2,6-diphenacylpyridine in form of its dioxime ($C_{21}H_{19}N_3O_2$) was converted to the anilide of pyridyl-2,6-diacetic acid ($C_{21}H_{19}N_3O_2$) by means of a Beckmann rearrangement. On reduction and hydrolysis of pyridyl-2,6-diacetic acid dianilide, nor-lobelinic acid ($C_9H_{15}NO_4$) was obtained, which by treatment with formaldehyde and formic acid gave lobelinic acid ($C_{10}H_{17}NO_4$). The new compounds prepared in this work were: pyridyl-2,6-diacetic acid diethyl ester hydrochloride ($C_{13}H_{17}NO_4.HCl$); nor-lobelinic acid ($C_9H_{15}NO_4$), its anilide ($C_{21}H_{25}N_3O_2$), and its dimethyl ($C_{11}H_{19}NO_4.HCl$) and diethyl ($C_{13}H_{23}NO_4.HCl$) esters as hydrochloride salts; and the dimethyl ($C_{12}H_{21}NO_4.HCl$) and diethyl ($C_{14}H_{25}NO_4.HCl$) esters of lobelinic acid as hydrochloride salts.

In other attempts at the preparation of pyridyl-2,6-diacetic acid, the reaction of dipicolinic acid dichloride with diazomethane was studied. The Wolff rearrangement of the diazoketone obtained could not be effected. The reaction of 2,6-lutidine with phenyl lithium and subsequent carbonation of the lutidyl lithium complex was also attempted. The sought after bilaterally substituted lutidine was not obtained. After carbonation and subsequent esterification of the complex, 6-(α-picolyl) acetic acid ethyl ester ($C_{10}H_{13}NO_2$) was obtained along with another compound believed to be 6-(α-picolyl benzoylmethane ($C_{14}H_{13}NO$).

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THE CRYSTAL AND MOLECULAR STRUCTURE OF 1,2-DICHLOROETHANE AT -140°C. THE CRYSTALLOGRAPHY OF SOLID DINITROGEN TRIOXIDE AT -115°C. AND THE CRYSTALLOGRAPHY OF CYCLOHEPTATRIENE

(Publication No. 4874)

Thomas Binnington Reed, Ph.D.
University of Minnesota, 1952

Below the broad, very marked transition, the monoclinic unit cell of the low temperature modification of 1,2-dichloroethane has the parameters a = 4.66A, b = 5.42A, c = 7.88A, and β = 103.5°. The molecule is in the extended, trans configuration with dimensions C-Cl = 1.80 ± 0.02A, C-C = 1.49 ± 0.04A and ∠ C-C-Cl = 105.5°. While the high temperature modification shows disorder about approximately the Cl...Cl axis, the low temperature modification is completely ordered.

The unit cell of N_2O_3 crystals at -115°C is tetragonal with a = 16.4A and c = 8.86A, and contains 32 molecules of N_2O_3. Complete hkl data from single crystals indicate that the space group is D_4^{10} I_{4_12}. The presence of an abnormally high decline of intensities with increasing angle of scattering, and the presence of marked transition at roughly -125°C suggest a disordered structure. Although the electron density projection along c was refined to an agreement of R = 0.22 (observed reflections only), an interpretation of this projection could not be made, and the structure remains unsolved.

Cycloheptatriene forms a cubic crystal, a = 10.6A with eight molecules in the unit cell. Because of the extremely rapid decline of intensities at higher scattering angles and the very small number (5) of observed reflections, the structure was not obtained, though several likely models were tried.

The three appendices deal with IBM machines applied to x-ray calculations, a short accurate method of estimating temperature and scale factors and x-ray densitometry.

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THE SYNTHESIS OF SOME ESTERS OF SOME N-ALKYL p-CARBOXYBENZAMIDINES

(Publication No. 4876)

William Joseph Rost, Ph.D.
University of Minnesota, 1952

Since the introduction of Phenacaine by Tauber in 1894, other compounds of the amidine type have been prepared and shown, in some cases, to possess marked local anesthetic properties. Further studies of the amidine type compounds as local anesthetics have been carried out in this laboratory. Since most of the successful local anesthetics marketed today are esters of p-aminobenzoic acid, these investigations have turned toward the preparation of the esters of p-carboxybenzamidine which is the amidine analog of the previously mentioned p-aminobenzoic acid. Numerous compounds containing aliphatic, alicyclic and aromatic ester residues have been prepared in this laboratory. The effect of halogen substitution in the ester residue has also been studied. Some of these compounds have shown promise as local anesthetics because of the degree of their activity, their duration of action and their low toxicity.

A procedure has been described in this work for the preparation of a pure p-cyanobenzoic acid in molar quantities with yields of 70%. The acid was converted to the various esters in the usual manner by the use of thionyl chloride. Conversion of the nitrile to the amidine was accomplished by modifications of Pinner's method.

In this work two new esters of p-carboxybenzamidine have been prepared to further study the contribution of the ester residue to the activity of the compound. To investigate the effect of the ring size and saturation of the aromatic ring, the cyclopentyl and hexahydrobenzyl esters were prepared for comparison of activity with the cyclohexyl and the benzyl ester. These latter esters, synthesized earlier, have shown marked activity.

When injected in man, some of these compounds have produced an erythema at the site of injection. This was believed due to the extreme basicity of the free amidine group. In an attempt to reduce this basicity and consequently eliminate the erythema, a series of these same esters has been prepared in which the amidine portion was monosubstituted with a simple alkyl group. The ester residues of the compounds prepared were the benzyl, chlorethyl, cyclohexyl, cyclopentyl and the hexahydrobenzyl. The N-alkyl substitutions were methyl, ethyl, n-propyl and n-butyl. These compounds will be tested for local anesthetic activity at a later date.

Reports in the literature have indicated antibiotic activity for some compounds of the amidine type. The compounds prepared in this work will also be screened for any possible activity of this type.

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METAL DEACTIVATORS FOR VEGETABLE OIL SYSTEMS

(Publication No. 4900)

Arthur William Schwab, Ph.D.
Bradley University, 1952

A study of the relative effectiveness of various metal scavengers on the stability of vegetable oils was made. Model compounds capable of forming five- and six-membered chelate rings have been prepared and evaluated. For maximum effect the chelating agent should have at least two carboxy groups alpha or beta to the co-ordinated atom. The order of effectiveness of the co-ordinating atoms in this study was found to be S>N>O. A reason for this order is not known but, significantly, it follows the order of increasing electronegativity. Chelate rings of five members have been found to be more effective as scavengers than rings of six members, and the effectiveness increases as the number of connecting rings in the system increases.

Chelidamic acid has been found to be an excellent metal deactivator for edible oils, especially oils to be used in baked products or in deep-fat frying processes, because of its high heat stability. The metal complex of chelidamic acid and ferric iron has four five-membered and two six-membered rings which are believed to account for its effectiveness. In an attempted synthesis of 1,1′ ethylene bis [2,6 dicarboxy-4-pyridone], a new salt of chelidonic acid has been discovered. When treated with hydrochloric acid, the ethylenediamine salt of chelidonic acid yields a new cyclic lactam. The reduced form of this lactam is a heterocyclic ring system which has not previously been reported.

The method of preparation and the physical constants of a new sulfur compound, α, α' thiodicaproic acid, are described for the first time. This acid shows good oxidative stability, but imparts a poor initial flavor to the oil. If not satisfactory for the edible oil industry, it might find application in the manufacture of soap, petroleum, or other nonedible products.

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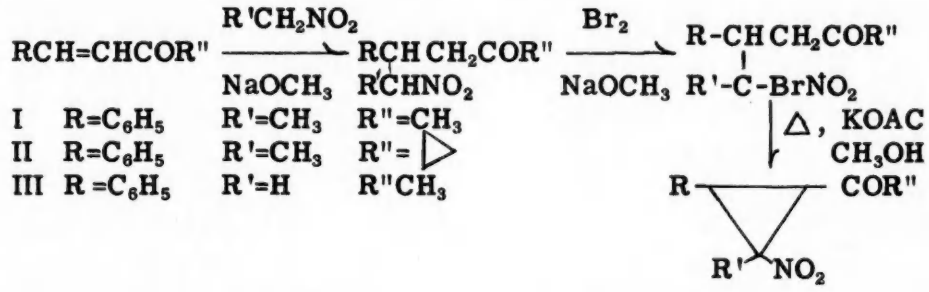
CYCLOPROPANE XI: ACTION OF BASES UPON CERTAIN TERTIARY NITROCYCLOPROPYL KETONES

(Publication No. 4879)

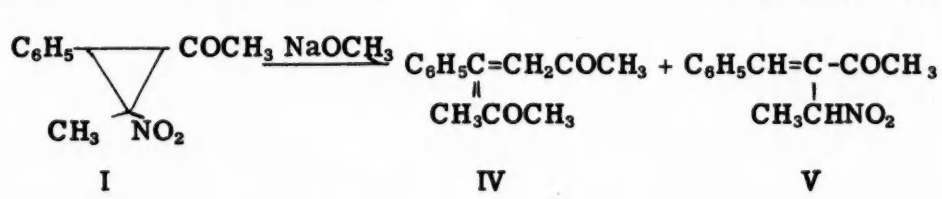
John Sheldon Showell, Ph.D.
University of Minnesota, 1952

The mechanism of the reaction between sodium methoxide (bases in general) and nitrocyclopropyl ketones has been studied, and the effect of the nature and of the relative configuration of the substituents

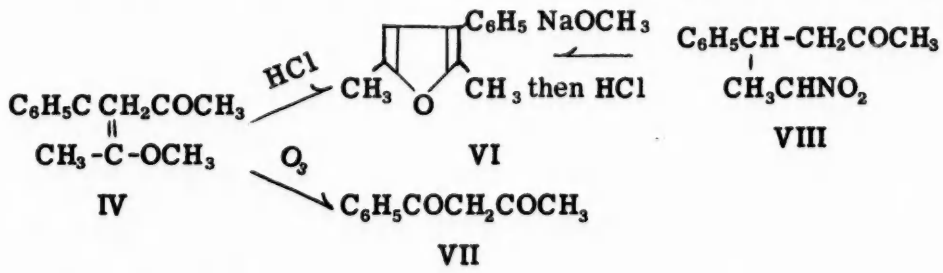


has been investigated. 3-phenyl-2-nitro-2-methyl-cyclopropyl methyl ketone (I), 3-phenyl-2-nitro-2-methycyclopropyl cyclopropyl ketone (II) and 3-phenyl -2-nitrocyclopropyl methyl ketone (III) were synthesized by the general synthetic method of Kohler.

The structure of the enol ether IV was established by its conversion to the furan VI which was synthesized via the Nef reaction from the nitro ketone VIII. Ozonolysis of IV gave benzoyl acetone (VII) which indicated that the double bond in IV was to the carbonyl

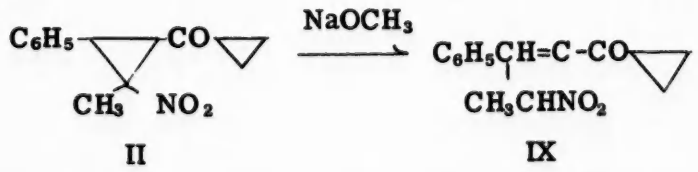


The nitrocyclopropyl ketone I was found to react with sodium methoxide to form the enol ether of a group. The base soluble compound V decolorized potassium permanganate, gave an orange-red

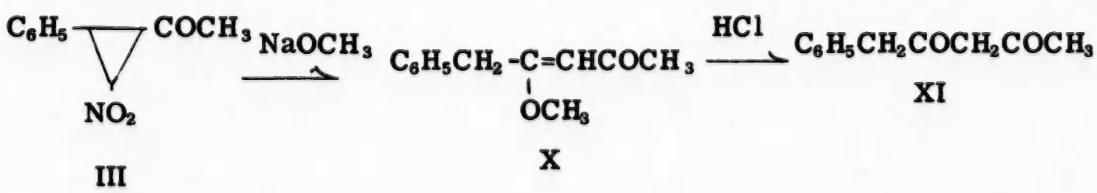


1,4-diketone (IV). However, the course of the reaction was highly dependent upon the relative configuration of the substituents attached to the cyclopropane ring. A solid isomer of I reacted with sodium methoxide to give a quantitative yield of the enol ether IV;

precipitate with 2,4-dinitrophenyl hydrazine, and gave a positive test for the nitro group. Upon the basis of this information it was assigned the structure of V.



The nitrocyclopropyl ketone II (only one isomer isolated - a solid) gave only a base soluble



compound IX when it was subjected to the action of sodium methoxide.

The structure of IX was assigned upon the basis of the following tests: it immediately decolorized potassium permanganate, gave a positive test with 2,4-dinitrophenyl hydrazine, and gave a positive test for the nitro group.

The nitrocyclopropyl ketone III when subjected to the action of sodium methoxide gave only the enol ether X. The structure of X was established by its conversion to the known phenylacetyl acetone XI.

A general mechanism for the reaction between all nitrocyclopropyl ketones and sodium methoxide (bases in general) has been proposed. Moreover, for the case in which the nitrocyclopropyl ketone has no hydrogen atom attached to the carbon atom holding the nitro group, the mechanism has been elaborated in some detail. In setting up the general mechanism, the following three assumptions have been made: 1) the reaction between sodium methoxide (or a base in general) and a nitrocyclopropyl ketone is an elimination reaction and is initiated by the attack on a hydrogen atom attached to the cyclopropane ring; 2) there is an interaction between the nitro and carbonyl groups; and 3) there is a coulombic repulsion between the attacking anion and the nitro and carbonyl groups. These three assumptions permit the classification of the reaction between nitrocyclopropyl ketones and sodium methoxide (or a base in general) upon the basis of the number and the position of attachment of the hydrogen atoms to the ring. Further, it is possible to consider the effects of relative configurations of the substituents and to predict the position of cleavage in the cyclopropane ring from a knowledge of the configuration. Conversely, knowing the structure of the products obtained by action of alkali upon a nitrocyclopropyl ketone, a configuration can be assigned to the cyclopropane with reasonable certainty.

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CHEMISTRY, BIOLOGICAL

THE CONSTITUTION OF GLYCOGEN

(Publication No. 4838)

Mahmoud A. O. Abdel-Akher, Ph.D.
University of Minnesota, 1952

Glycogen prepared from different sources and subjected to a purification process to remove protein showed similar properties.

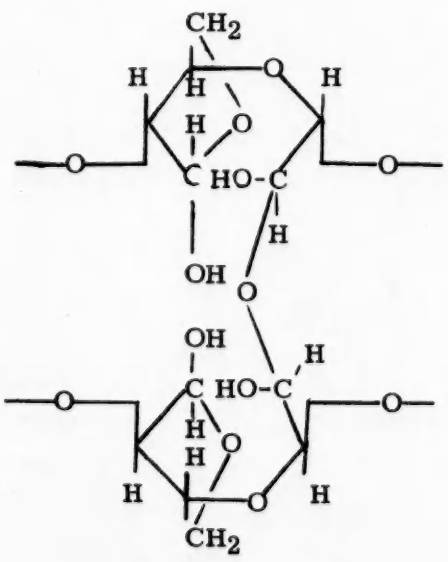
In order to facilitate the determination of the length of the repeating unit of a larger number and variety of glycogen samples, a periodate oxidation procedure which avoids over-oxidation was developed. The method involving the use of a low concentration of sodium periodate (0.1N) and a low temperature (5°C.) proved to be very satisfactory and no over-oxidation was observed when applied to the oxidation of model compounds such as methyl-α-D-glucopyranoside or methyl-β-maltoside.

Thirty-seven different glycogen samples have been tested by this periodate method, including samples of glycogen obtained from sources which have been reported to provide the 18 unit type of glycogen. The results showed that all the samples of glycogen, irrespective of the source, had a repeating unit containing approximately 12 glucose residues. The repeating unit of 18 glucose residues was not encountered in these studies.

A comparison has been made of the rate of the consumption of periodate with the production of formic acid during the oxidation of certain carbohydrates with sodium periodate and the structural significance of the results has been discussed.

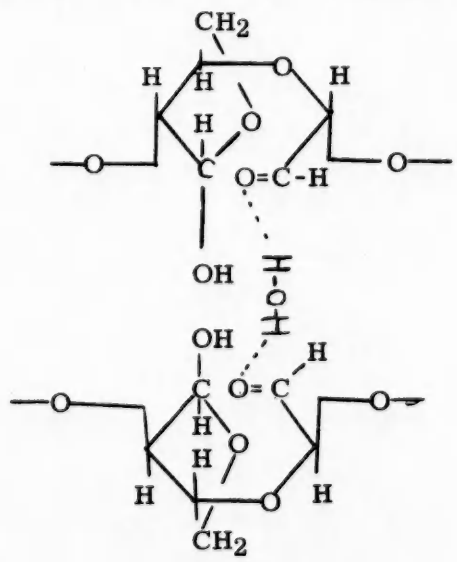
Glycogen from different sources was oxidized with periodate, and a successful procedure was found for the isolation of the glycogen polyaldehyde in almost quantitative yield.

The elementary analysis for these glycogen polyaldehydes is very close to that calculated for $C_6H_8O_5 \cdot 1/2\ H_2O$. According to this result, one molecule of water is shared between two aldehydic groups, as in the two structures (a) or (b) given below:



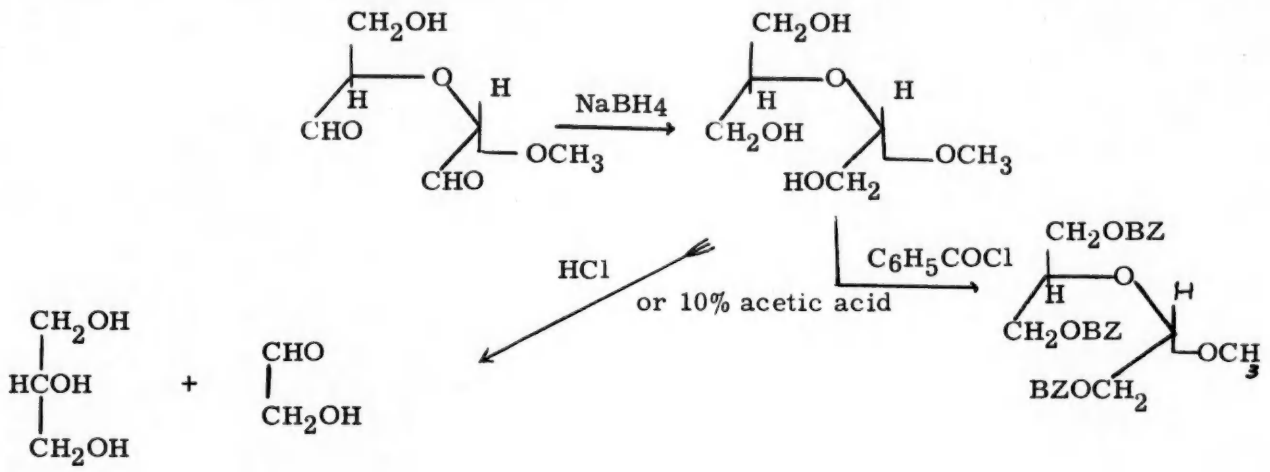
(a) Hemiacetal

or



(b) Hydrogen bond

To avoid the troublesome free aldehydic groups during the structural study, glycogen polyaldehyde

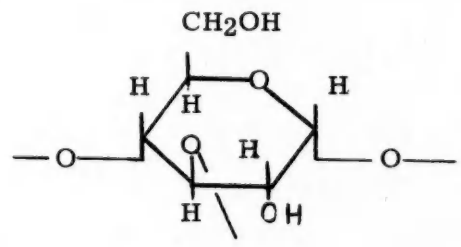


Glycerol Glycolic aldehyde

was reduced to convert the carbonyl groups to alcohol groups. Attempts to reduce the glycogen polyaldehyde with hydrogen in the presence of a Raney Nickel catalyst resulted in the hydrogenolysis of the compound.

Reduction with sodium borohydride was first tried on model compounds such as α-methylglucopyranoside dialdehyde which was successfully reduced to the corresponding alcohol. The trihydric alcohol produced in the reduction was isolated and characterized as illustrated in the above chart.

The components of glycogen polyalcohol after acid hydrolysis were identified both by the preparation of derivatives and by paper partition chromatography. The polyalcohol was shown to consist of glycerol, erythritol, glycolic aldehyde and, in addition, a small amount of glucose (0.6 - 0.7%). The formation of the glucose residues in glycogen joined through positions 1, 3 and 4 as shown below.



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HORMONAL INFLUENCES ON THE CARBOHYDRATE METABOLISM OF ISOLATED MUSCLE

(Publication No. 4848)

William D. Cohen, Ph.D.
University of Minnesota, 1952

The preparation employed was the adrenal-demedullated albino rat, eviscerated by a rapid, single-stage method, and subsequently maintained for several hours by the continuous intravenous infusion of glucose in saline solution. To these aminals the following hormones were administered concurrently with the glucose-saline infusion: insulin, purified pituitary growth hormone and cortisone. Also some eviscerated animals were maintained in hyperglycemia by the administration of excess glucose, and hypoglycemia was allowed to develop in certain animals by infusion with inadequate amounts of glucose.

Glycogen was determined in abdominal muscle before evisceration, and blood sugar levels were determined at intervals during the infusion period. After removal of the diaphragm, a sample of this tissue was also analyzed for glycogen, while the remaining diaphragm was incubated in a glucose-containing medium of extracellular type; one portion of diaphragm in medium containing insulin, the other in a medium devoid of insulin. After incubation for 2 hours, residual glucose in the media and glycogen in the diaphragm pieces were determined.

By use of this technique it was possible to study the effects of hormone treatment on the level of glycogen in diaphragm muscle after evisceration, and the effects of administration of various hormones on glucose uptake and glycogen formation by surviving diaphragm.

The following results were obtained:

1. Glycogen content of diaphragm was significantly increased by the infusion of insulin with glucose, and also by the administration of excess glucose. The diaphragm glycogen level was not altered by hypoglycemia or the infusion of growth hormone or cortisone concurrently with glucose.

2. In animals infused with glucose plus insulin, as contrasted with those given glucose alone, glucose uptake by control tissue was increased, while in vitro insulin effects, on both glucose uptake and glycogen formation, were decreased. These effects were not significantly altered by the removal and replacement of approximately 50 percent of the blood volume immediately before sacrifice. It is suggested that they were due to the relatively tenacious binding of insulin to the muscle cell.

3. In those preparations in which hypoglycemia was allowed to develop, in vitro glucose uptake by control tissue was increased, while the insulin effect on glucose uptake, and possibly also on glycogen formation, was decreased. Conversely, when hyperglycemia was induced by increasing the rate of glucose administration, glucose uptake by control tissue was depressed. These effects may have been due to a dependence of the rate of utilization of bound insulin upon the amount of glucose presented to the tissue.

4. No significant effects on in vitro glucose uptake or glycogen formation by diaphragm were observed after the intravenous infusion of growth hormone or cortisone, singly or in combination, to eviscerated rats. Possible reasons for this lack of effects were discussed.

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ELECTROPHORETIC STUDIES ON DESOXYPENTOSENUCLEOPROTEINS FROM RAT LIVER CELLS

(Publication No. 4658)

Hyla Armstrong Cook, Ph.D.
Stanford University, 1953

Desoxypentosenucleoprotein is one of the principal substances found in the nuclei of plant and animal tissue cells. A highly viscous solution of desoxypentosenucleoprotein in 1 M NaCl was prepared from rat liver tissue by the method of Mirsky and Pollister or from isolated nuclei obtained by differential centrifugation in 0.88 M sucrose.

Electrophoretic experiments were performed on the desoxypentosenucleoprotein in buffers of very low (0.02 - 0.026) ionic strength or high (0.6 - 0.8) ionic strength at which extremes the desoxypentosenucleoprotein is soluble. In buffers of 0.6 to 0.8 ionic strength at pH 9, the desoxypentosenucleoprotein showed two moving boundaries which both migrated to the anode, although the trailing one was very slow. The mobility of the leading component ranged from -6.2 to -9.6 x 10^{-5} $cm.^2$ x $sec.^{-1}$ x $volt^{-1}$. Several electrophoretic patterns are shown for these experiments in buffers of high ionic strength.

Chemical analyses were made of the two components shown by the electrophores of the desoxypentosenucleoprotein in a borate-chloride buffer of 0.6 ionic strength at pH 9. These analyses indicated that the leading component was a desoxypentosenucleate-rich histone complex while the second component was a desoxypentosenucleate-poor histone complex. Both components seemed to be contaminated with a tryptophan-containing protein, but the second, more heavily. The presence of these substances was deduced on the basis of chemical analyses for desoxypentosenucleate by means of the Dische test for desoxypentose, tryptophan-containing protein, by the glyoxylic acid test for tryptophan, and histone, as indicated by a biuret test for total protein, or a Sakaguchi test for arginine.

The rat liver desoxypentosenucleoprotein traveled as one negative electrophoretic component in a phosphate buffer of 0.02 ionic strength at pH 7.7 with a mobility of approximately -13 x 10^{-5} $cm.^2$ $sec.^{-1}$ x $volt^{-1}$. Higher mobilities of -18 to -21 mobility units were obtained in a phosphate buffer of 0.02 ionic strength containing 0.006 ionic strength sodium citrate. Typical electrophoretic patterns are shown.

Dialysis experiments showed that single preparations of desoxypentosenucleoprotein traveled either as one electrophoretic component or two components at pH's between 7.7 and 9.0 depending on whether the ionic strength of the buffer was low (0.026 ionic strength) or high (0.6 to 0.8 ionic strength).

The electrophoretic experiments in conjunction with the chemical analyses of the components seemed to offer electrophoretic evidence that the fibrous desoxypentosenucleo-histone dissociated in a solution of high ionic strength. This accorded with the ideas of Mirsky and Pollister (J. Gen. Physiol., 30, 101, 117 (1946)) and others.

Mechanisms as to the way the two components were formed, either as a result of partial dissociation of a reversibly dissociable nucleohistone complex which traveled with one or both of the components, or as a result of complete dissociation of the nucleohistone into nucleate-rich and nucleate-poor histone products are discussed.

Attempts were made to determine the number of high weight components which were present in solutions obtained by extracting isolated rat liver chromosomes directly with water containing either 0.001 M sodium citrate or 0.002 M sodium arsenate as enzyme inhibitors. Two initial experiments indicated that there were possibly three components present, of which only one should have corresponded to nucleohistone. However, the results were inconclusive because later extractions all resulted in the production of insoluble gels which were not satisfactory for electrophoresis.

A survey of the pertinent literature was made and the author's experiments were discussed in their relation to this literature.

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THE BIOCHEMICAL BEHAVIOR OF WHEAT FLOUR DOUGHS SUPPLEMENTED WITH MILK SOLIDS

(Publication No. 4854)

Arthur Leonard Gordon, Ph.D.
University of Minnesota, 1952

Extensive research had shown that when skim-milk was given a minimum heat treatment of 73°C. for 30 minutes, it had good baking characteristics when used as bread dough supplements. Unheated or inadequately heated milk produced loaves of bread 10-15% smaller in volume and inferior in other baking characteristics. This heat-labile effect had been shown to reside in the serum protein fraction of milk and to be non dialyzable. A crystalline protein, beta-lactoglobulin, which is isolated from serum protein produces excellent bread when used as the native protein. Beta-lactoglobulin will account for the sulfhydryl groups of milk; consequently, this does not agree with the popular theory that the sulfhydryl proteins of milk exert a reducing effect on bread doughs and thus depress the loaf volume.

Casein and lactose also depress loaf volume but their effects are not overcome by heat treatment. In this respect the loaf volume depressing action of serum proteins is unique.

The objectives of the present work were as follows:

1. Compare effects of casein and whey protein.
2. Investigate possible interactions of casein and whey protein with gluten.
3. Determine what fraction of whey protein contains the heat-labile factor.
4. Determine if heat-labile factor is a proteolytic enzyme or activator.

Baking studies with milk fractions produced by supercentrifugation, acid precipitation of casein, and rennet clotting revealed that the casein fractions produced bread inferior in loaf volume to that made with whey fractions.

The casein and whey fractions both produced bread inferior to that of doughs made without milk. All three casein preparations were similar in baking behavior; the same was true for the whey fractions.

By washing gluten from doughs containing milk solids, it was observed that interactions occur between milk proteins and flour proteins, principally between casein and gluten. When milk was heated before it was incorporated into bread doughs, considerably more milk protein would form a complex with the gluten than was the case with unheated milk.

The binding between casein and gluten was not irreversible. Extended extraction of a gluten obtained from a casein supplemented dough with a bicarbonate buffer in which casein is soluble quantitatively removed the casein.

Gluten obtained by washing milk supplemented doughs was much less cohesive and elastic than gluten from controls. This suggests that casein becomes interspersed in the gluten protein matrix to produce complexes which do not have the strength or elasticity of gluten itself.

A series of experiments have shown that serum proteins are not altered from a baking standpoint by the high salt concentrations used in fractionation. Similarly, beta-lactoglobulin is apparently unchanged in baking behavior when it is isolated as a crystalline protein; consequently, the baking studies with beta-lactoglobulin should be valid.

A protein was isolated from the lactalbumin fraction which was insoluble at a pH of 4.0-4.6, a pH range within which beta-lactoglobulin is fairly soluble. This protein was not the baking factor which was being sought.

Baking studies with ammonium sulfate fractions of acid whey, individually and in combinations, demonstrated that the classical lactoglobulin fraction of serum protein contains the deleterious baking factor. This fraction is very complex. It is turbid and somewhat unstable; it contains several protein components as shown by electrophoretic analysis.

The baking factor is not a proteolytic enzyme; it is non reducing or possibly weakly reducing in nature; and it is not an activator of latent flour proteases. The mechanism by which the baking factor of milk depresses the loaf volume of bread is not related to the sulfhydryl content of the fractions.

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A STUDY OF THE MECHANISM OF POTASSIUM ACTIVATION OF PYRUVIC PHOSPHOFERASE

(Publication No. 4862)

John Frederick Kachmar, Ph.D.
University of Minnesota, 1952

A detailed kinetic analysis of reversible enzyme activation and inhibition is presented. It is shown that specific activation or inhibition equations can be derived from a single, generalized equation by proper selection of kinetic parameters. Enzyme activation reactions are assumed to proceed by formation of a ternary complex composed of enzyme, activator, and substrate. Five possible pathways of reaction between the three components leading to ternary complex formation have been analyzed and equations expressing reaction velocity as a function of substrate and activator concentrations formulated. The possible reaction mechanisms described by the alternate pathways can be differentiated experimentally. For a given pathway, the form of the velocity equations will depend on whether the enzyme reaction is assumed to proceed under equilibrium or steady-state conditions.

The analysis of enzyme activation has been applied to a study of the mechanism of potassium activation of pyruvic phosphoferase, the enzyme catalyzing phosphate transfer from phospho-(enol)pyruvate to adenosine diphosphate. A rabbit muscle enzyme preparation, partially purified by a combination of

ammonium sulfate and cold-temperature-ethanol fractionation was employed. The extent of reaction at pH 7.4 and 37°C was followed by measuring the pyruvate formed in a reaction system constituted of buffer, magnesium ion, adenosine triphosphate, hexokinase, glucose, substrate and activator. Within limits of experimental error, no reaction occurred in the absence of added activator ions. Of six ions investigated, only potassium, rubidium, and ammonium functioned as effective activators. The dissociation constants (K_A) for the respective enzyme-substrate complexes (EA) were found to be $1.14 \pm 0.07 \times 10^{-2}$M, $1.05 \pm 0.07 \times 10^{-2}$M, and $1.13 \pm 0.24 \times 10^{-2}$M.

Sodium ion was observed to be weakly active; lithium and calcium were inactive. All three ions could counteract or inhibit potassium activation. Calcium inhibition could be partly overcome by increase in potassium concentration; the data, however, were consonant with neither "true" competitive nor non-competitive inhibition.

Reaction velocity was found to decrease with increase in activator ion concentration above certain optimum levels, which for potassium, rubidium, and ammonium ions were respectively: 0.14 to 0.15 M; 0.075 to 0.080 M and 0.075 to 0.036 M. This velocity decrease is attributed primarily to the formation of inactive higher-order enzyme-activator complexes (EA_2 or EA_n) and partly to non-specific ionic strength effects.

The dissociation constant for the enzyme-phosphopyruvate complex (K_M) was found to be $8.76 \pm 0.30 \times 10^{-5}$M. Both K_A and K_M were found to be independent of the concentration of the other component. Preliminary measurements give about 2 to 3×10^{-4}M as the K_M for adenosine diphosphate.

The data point to an independent combination of potassium and phosphopyruvate with the magnesium and adenosine diphosphate saturated enzyme, under equilibrium conditions, to form the active ternary complex as the most probable mechanism of the pyruvic phosphoferase reaction. The prior binding of either component onto the enzyme appears not to alter the bond intensity between the enzyme and the other component. Certain reaction mechanisms are eliminated as not consonant with the data, but a definite choice cannot be made between the above mechanism and a possible compulsory initial association of enzyme with either component under steady-state conditions.

It is hypothesized that the capacity of potassium, ammonium and rubidium ions to activate the enzyme is connected with certain like properties of these ions associated with their hydration, the active ions having hydrated volumes of essentially identical size, whereas the inactive ions are of appreciably larger magnitude. Activation is conceived to be associated with certain critical changes in the configuration of the enzyme protein, such as displacement of adjoining structures, and the size of the combining ion may determine the magnitude of such changes in the geometry of the enzyme surface.

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THE PREPARATION AND SEDIMENTATION BEHAVIOR OF NONFIBROUS DESOXYPENTOSENUCLEOPROTEIN

(Publication No. 4678)

Donald Walter Kupke, Ph.D.
Stanford University, 1953

Nonfibrous desoxypentosenucleoprotein (DNP) was extracted with 1 M NaCl from rat liver chromatin particles and from nuclei. The chromatin particles were isolated from concentrated sucrose solutions containing citrate by high speed centrifugation; the nuclei were prepared with 0.002 M citric acid at pH 6.0 and washed with 0.02 M acetate buffer. When NaCl was added to the initial blending medium in either procedure, the DNP was extracted in the well-known fibrous form.

The nonfibrous DNP was purified to constant composition by repeated cycles of dissolving in water from the dry state, centrifuging, dialyzing, and lyophilizing. The final products contained 16.8 to 17.0 percent nitrogen and 4.13 to 4.19 percent phosphorus; whereas, partially purified preparations gave lower values. The ultraviolet absorption curve and the solubility behavior of this DNP were similar to those reported for the fibrous form.

Sedimentation studies on nonfibrous DNP in nearly neutral solutions showed three boundaries, one of principal and two of minor proportions. Plots were made of the $s_{20,w}$ against total nucleoprotein concentration in 1 M NaCl for the principal boundary from preparations in various states of purity. The $s_{20,w}$ values which were approached at zero nucleoprotein concentration for different partially purified preparations varied considerably. The values from four terminally purified preparations, however, were essentially the same and, in addition, were lower than any from the less purified preparations. All plots were approximately parallel regardless of the state of purity of the DNP. These results suggest the removal of symmetrically adsorbed substances from the surface of the principal boundary particles during the purification cycle. No appreciable differences in the rate of the principal boundary were found between pH 5.4 and pH 7.7, but splitting was observed at pH 9.1 and above. Widely different rotor velocities had no effect on the rate of this boundary. The principal boundary was markedly sensitive to ionic strength. The peak became polydisperse and its rate increased sharply as the NaCl concentration approached the DNP precipitation zone from either side. An equilibrium between particle aggregates is proposed to explain this behavior. The effect of total nucleoprotein concentration (c) on the $s_{20,w}$ of the principal boundary was determined at four different ionic strengths. The line of regression was calculated from the data for each series; the equations are as follows: 2 M NaCl, $s_{20,w} = 8.61 - 3.15\ c$; 1 M NaCl, $s_{20,w} = 13.2 - 4.54\ c$; 0.005 M NaCl, $s_{20,w} = 20.0 - 5.49\ c$: distilled water, $s_{20,w} = 10.05 - 0.59\ c$. Because of the increased solvent density in the high ionic strength studies, the probability of serious error in the extrapolated sedimentation constant is

discussed. Little or no primary charge effect was noted in the two low ionic strength series.

The two minor boundaries were studied in less detail. The diffuse boundary remained near the meniscus and was similar in sedimentation behavior to that of histone extracted from the DNP. The more rapidly moving boundary was characterized by a nearly uniform rate under varying conditions of ionic strength and total nucleoprotein concentration. A small fraction of the DNP, containing the two minor components, but not the principal component, remained soluble in 0.14 M NaCl. This fraction contained nitrogen, phosphorus, and desoxypentosenucleic acid (DNA) in nearly the same proportions as whole DNP. These results suggest that the faster of the two minor components may be rich in DNA. Sedimentation analysis of the insoluble fraction, however, continued to show the presence of the two minor boundaries in addition to the principal boundary, despite the repeated extraction of the former. A partial dissociation in aqueous solutions of the particles from the principal boundary into those of the two minor boundaries is, therefore, proposed.

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INTERRELATIONSHIPS OF FECAL, BODY, AND DIETARY FATS: A STUDY OF FAT EXCRETION AND FAT DEPOSITION IN RATS USING SIMPLE TRIGLYCERIDES AS DIETARY FAT

(Publication No. 4870)

Leonard N. Norcia, Ph.D.
University of Minnesota, 1952

Fat excretion and fat deposition was studied in two groups of rats by conditioning the rats for 30 days on diets containing either 15% tripalmitin or 15% olive oil; then placing 5 animal groups of the conditioned rats on one of several test diets for 10 days, during the last 7 of which feces were collected for analysis, and upon sacrificing the animals after the 10 day period body tissues were obtained for fat analysis. The test diets included a fat free diet, a tripalmitin diet, a triolein diet, and a tripalmitin-trilinolein diet. The fat analysis of the samples obtained included: unsaponifiable matter, total fat acids, melting point of fat acids, neutralization equivalents, iodine values of fat acids, fat acid composition, and peroxide values.

Two preliminary experiments were performed on rats utilizing diets containing either 15% lard or 15% tripalmitin. Studies of fecal and body fats of these groups of animals were also made.

The aspects of fat excretion considered were the endogenous fecal fat excretion and the digestibility of the fats in the test diets.

In addition to deposition of dietary fat as body fat certain aspects of fat acid metabolism are discussed.

Ratios of saturated to monoethenoic acids of fecal fats obtained from tripalmitin and olive oil conditioned rats placed on a fat free diet were the same, and were independent of these same ratios for the body fats which differed in the two groups of animals according to conditioning. These data were interpreted as indicating that changing the body fats by conditioning is not reflected in the nature of the endogenously excreted fat.

From studies in which triolein, tripalmitin, and tripalmitin-trilinolein were the sole dietary fats data was obtained which indicated that the fecal excretion of non-dietary fat acids is not affected in quantity or composition by the presence of fat in the diet; however, the results with the tripalmitin containing diets were not entirely conclusive.

The ratios of saturated to monoethenoic acids in the depot fats (perirenal and mesenteries) of rats conditioned on tripalmitin were greater than those ratios for animals conditioned on olive oil.

The effect of tripalmitin conditioning with a diet deficient in essential fat acids was manifest in rat body fats by: a depletion of fat reserves, a decrease of iodine value of body fats, a depletion of diethenoic and tetrathenoic acids, a relative increase of monoethenoic acids of liver, pooled organs, and hams samples with relative decreases of saturated acids for the same samples. The relative amounts of monoethenoic acids in such an experiment appeared to be correlated to the amount of dietary choline.

Diethenoic acids increased markedly in body fats of rats conditioned on olive oil and placed on a tripalmitin-trilinolein dietary regimen. Diethenoic acids increased markedly only in depot fats (perirenal and mesenteries) of rats conditioned on a tripalmitin diet deficient in essential fat acids and placed on a tripalmitin-trilinolein dietary regimen.

Following depletion of tetraethenoic acids in rats by tripalmitin conditioning with a diet deficient in essential fat acids the tetraethenoic acids of the liver showed a very substantial increase by placing the animals on a tripalmitin-trilinolein dietary regimen for 10 days.

The effects obtained on body fats of differently conditioned animals by switching groups of the animals to several different test diets is discussed.

The digestibility of tripalmitin by rats of ca 2 months age was found to vary from 31-59%.

The digestibility of tripalmitin was found to be increased following conditioning on tripalmitin.

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KINETIC STUDIES OF ENZYME REACTIONS: I. EXTENSION OF KINETIC ANALYSIS II. MECHANISM OF ACTION OF 3-PHOSPHOGLYCERALDEHYDE

(Publication No. 4878)

Harold L. Segal, Ph.D.
University of Minnesota, 1952

The equations for enzyme inhibition obtained by the Michaelis-Menten treatment have been reexamined by steady state kinetics and further generalized and extended to include non-total inhibition. Other plausible mechanisms of inhibition have been shown to be indistinguishable from competitive inhibition by the usual criteria, but may be distinguished by further analysis as herein suggested.

Equations for the rates of enzyme reactions involving an activator, coenzyme, or second substrate have been derived by both the equilibrium and steady state methods for both essential and non-essential activation. The explicit assumptions of equilibrium analysis have been pointed out.

On the basis of these equations it has been shown how kinetic data may be utilized to test the validity of postulated reaction mechanisms. Various reaction pathways are readily distinguishable if the equilibrium analysis is valid. The steady state equations, while leading to useful relationships, do not always give as clear a distinction.

The 3-phosphoglyceraldehyde dehydrogenase reaction has been studied on the basis of the kinetic analysis and shown not to conform to a mechanism involving a compulsory combination of substrate with phosphate prior to oxidation.

An enzyme preparation has been obtained, which was fully active in the absence of cysteine, by extracting and recrystallizing the enzyme in the presence of versene which chelates heavy metal ions. Both 3-phosphoglyceraldehyde and glyceraldehyde have been shown to react with trishydroxymethyl aminomethane or cysteine so that inclusion of these compounds in a test system may lead to anomolous results.

Linear relationships could be obtained between amount of reaction and time in the presence of trishydroxymethyl aminomethane buffer with 3-phosphoglyceraldehyde as substrate, or with trishydroxymethyl aminomethane or veronal buffer with glyceraldehyde as substrate. With pyrophosphate buffer the initial velocity was greater but decreased with time. Veronal inhibited the reaction with 3-phosphoglyceraldehyde as substrate.

K_M values of 5.1×10^{-5}M for arsenate, 2.2×10^{-5} for 3-phosphoglyceraldehyde, and 7.5×10^{-2}M for glyceraldehyde were obtained. The V_m for glyceraldehyde was one-tenth as great as for 3-phosphoglyceraldehyde. Glyceraldehyde, unlike 3-phosphoglyceraldehyde, was oxidized in the absence of an added acyl acceptor.

Substrate was able to protect the enzyme against iodoacetate inactivation, even in the presence of added arsenate. This latter observation is interpreted to mean that substrate can add to the enzyme in another manner than through "aldehydolysis". Enzyme from which bound diphosphopyridine nucleotide had been removed by charcoal treatment was also protected against iodoacetate inactivation by substrate. Addition of diphosphopyridine nucleotide promoted the inactivation by iodoacetate.

By amperometric titration of the -SH groups of 3-phosphoglyceraldehyde dehydrogenase, there were shown to be 10-11 reductive equivalents / 99,000 gm. of enzyme, of which 3.5 were alkylated by iodoacetate under conditions which destroyed 80-90% of the enzyme activity. When substrate was included with the iodoacetate under conditions where 80-90% of the enzyme activity was retained, only 2.5 -SH groups were alkylated, so that apparently of the -SH groups alkylated by iodoacetate, only one was essential for enzyme activity, although there are two tightly bound diphosphopyridine nucleotide molecules per enzyme molecule.

It was possible to demonstrate the formation of an acyl-enzyme by the use of a sufficiently high concentration of enzyme that the reduction of the bound diphosphopyridine nucleotide could be measured on the spectrophotometer in the presence of substrate. Only 1/5-1/4 the potential diphosphopyridine reduction occurred unless additional diphosphopyridine nucleotide was added to drive the acylation reaction.

A mechanism for the overall reaction is presented which is in accord with these observations.

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STUDIES IN MAGNESIUM METABOLISM

(Publication No. 4884)

Francis Lloyd Stutzman, Ph.D.
University of Minnesota, 1952

Various aspects of magnesium metabolism have been investigated and several observations were made.

a) The normal human mean serum magnesium level is 1.94 ± 0.20 meq/L. during the summer and may be lower during other seasons of the year.

b) The serum magnesium level is the same in fasting and nonfasting states.

c) The Ca/Mg ratio in the serum is 2.63 ± 0.30 for the fasting and nonfasting groups combined.

d) The normal mean human cerebrospinal fluid level for magnesium is $2\text{-}40 \pm 0.14$ meq./L. and for calcium is $2\text{-}43 \pm 0.05$ meq./L. with a Ca/Mq ratio of 1.01 ± 0.06.

e) Routine laboratory methods for the determination of serum electrolytes (Na, K, Ca, Mg, P) yield values which are higher than those existing in vivo.

f) Patients with carcinoma tend to have serum magnesium values which are in the upper range of normal.

g) Renal disease with oliguria and anuria is accompanied by an elevation of the serum magnesium level.

h) Patients with hepatic cirrhosis have low serum magnesium values.

i) Patients with diabetes mellitus, particularly if the process is severe, have hypomagnesiemia.

j) Magnesium chloride administered intravenously to humans causes a decrease in the blood serum calcium with an increase in the urinary excretion of calcium. Blood serum sodium, potassium, phosphorus, glucose, and pyruvic acid also undergo characteristic changes. The urinary concentration of sodium, potassium, and phosphorus decreases.

k) Practically all magnesium administered parenterally can be accounted for in the urine within 24 hours.

l) Biliary secretion of magnesium rises substantially following intravenous administration of magnesium. A smaller increase is noted after oral administration.

m) The administration of glucose to humans is accompanied by characteristic changes in the serum and urine electrolytes. Magnesium decreases in the serum and the change in the normal individual is greater than in the patient with diabetes mellitus.

n) Small doses of insulin given intravenously to vagotomized patients has a variable effect on the serum magnesium. Other inorganic ions react in a more characteristic fashion.

o) The normal rabbit serum magnesium level is 2.03 ± 0.23 meq./L.

p) The blood glucose removal rate (K) method which had been devised for glucose tolerance testing in humans was found to be applicable to animal work. Using a glucose test dose of 1.25 gms., the (K) value in rabbits was $4.08 \pm 1.58\%$/min. and with a test dose of 2.50 gms. the (K) value was $3.99 \pm 1.78\%$/min.

q) The glucose removal rate is decreased by the intravenous injection of small amounts of magnesium. Calcium or potassium given with the magnesium exerts no significant action upon the magnesium effect.

r) Magnesium deprivation in rabbits causes a slowing in the blood glucose removal rate.

s) Alloxan diabetes in rabbits is accompanied by a substantial decrease in the serum magnesium.

t) Insulin injected into rabbits in amounts which were increased daily caused a brief rise and then a fall in the serum magnesium level.

u) Large injections of magnesium or insulin into dogs caused marked characteristic changes in the serum electrolyte pattern. The insulin depressed the blood serum magnesium up to 25% of the control value. From these experiments it was felt that the magnesium ion was intimately related to carbohydrate metabolism and to the other ions of the body and that disturbances of either carbohydrate or magnesium metabolism may be attended by reciprocal alterations in the other.

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A HEPARIN-LIKE BLOOD ANTICOAGULANT FROM SURF CLAMS

(Publication No. 4951)

Lyell Jay Thomas, Jr., Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: L. V. HEILBRUNN

A blood anticoagulant which shows similarities to mammalian heparin has been isolated from the tissues of the surf clam Spisula solidisima. Using a conventional procedure designed for extracting and purifying mammalian heparin, a product was obtained from Spisula mantle tissue which had an anticoagulant activity of 128 heparin units per milligram. This product was free of protein and gave positive tests for reducing sugar (after hydrolysis), hexoseamine and ester sulfate. It was shown that the mantle structures contain more heparin-like anticoagulant than the other tissues of this clam, and that there are at least two heparin-like substances of different origin in the mantle tissue. The mucous secretion of the inner mantle surface was shown to have anti-blood clotting activity but the mucus secretion of the shell side of the mantle was devoid of this activity. It was further demonstrated that a substance responsible for metachromatic staining in the connective tissue of the gills, palps and mantle is probably a heparin-like anticoagulant. It was suggested that this connective tissue substance and also the two types of mucus secretions perhaps serve specific functions in relation to the handling of calcium by the clam. The eggs of Spisula were shown also to contain a heparin-like substance. A partially purified product from the eggs had 22 heparin units per mg. It was demonstrated that this substance probably is contained within the egg and is not derived from the jellycoat.

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CHEMISTRY, INORGANIC

INTERACTION OF CADMIUM AND ZINC SALTS WITH THE ALKALINE ELECTROLYTES: SODIUM HYDROXIDE, SODIUM CARBONATE AND SODIUM ORTHOPHOSPHATE

(Publication No. 4917)

John Charles Clayton, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: WALLACE M. MCNABB & J. FRED HAZEL

The interaction of cadmium and zinc ions with sodium hydroxide, sodium carbonate and sodium orthophosphate was studied amperometrically,

conductometrically and potentiometrically (glass electrode).

In the titrations of cadmium sulfate with sodium hydroxide the end points occurred at approximately 77.5% equivalence of base, indicating the formation of $CdSO_4.3\text{-}1/2Cd(OH)_2$. When cadmium was titrated with sodium hydroxide, the end points were around 69.5% equivalence of alkali. This suggests the precipitation of the basic $CdCl_2.2Cd(OH)_2$.

When O.O2N zinc sulfate solutions were titrated with O.2N sodium hydroxide, the end points occurred at 75% equivalence of base, denoting the precipitation of the basic $ZnSO_4.3Zn(OH)_2$. In the presence of excess sulfate ions, titrations of O.OO2N zinc sulfate solutions with O.O2N sodium hydroxide had end points near 85% equivalence of base. When excess sulfate ions were absent the normal zinc hydroxide was obtained.

In the titrations of cadmium intrate, zinc nitrate and zinc chloride with sodium hydroxide, the end points occurred at 100% equivalence of base.

The influence of the anions in the basic salts was studied amperometrically. The basic cadmium sulfate was stable in the presence of excess nitrate ions, but was converted into the basic chloride in a potassium chloride medium. Titrations of both cadmium chloride and cadmium nitrate in a potassium sulfate supporting electrolyte indicated the formation of the basic sulfate. Solutions of cadmium chloride in potassium nitrate and cadmium nitrate in potassium chloride had titration end points which denoted the precipitation of the basic chloride. The basic sulfate was precipitated in titrations of O.O2N solutions of zinc sulfate in excess chloride and nitrate ions and in titrations of zinc chloride and zinc nitrate in potassium sulfate.

Chemical analysis confirmed the existence of the basic salts and their conversion into the normal hydroxides by excess alkali. Qualitative tests indicated the presence of chloride and sulfate ions in the basic salts.

When cadmium sulfate, cadmium chloride and cadmium nitrate were titrated with sodium carbonate, the end points occurred at 100% equivalence of carbonate. No reproducible results could be obtained for the titrations of zinc sulfate with sodium carbonate.

The end points for the amperometric-potentiometric titrations of zinc chloride and zinc nitrate with sodium carbonate were at 100% equivalence of carbonate. For the same systems the end points for the conductometric-potentiometric method were higher than the theoretical.

For the titrations of both cadmium and zinc salts with sodium carbonate, rapid addition of carbonate favored end points higher than the theoretical. Slight minima were observed in the potentiometric curves. Qualitative tests indicated the presence of carbonate in the precipitates.

When O.O2N solutions of cadmium sulfate, cadmium chloride and cadmium nitrate were titrated with sodium orthophosphate by amperometric and conductometric methods, the equivalence point was obtained. The potentiometric curves had end points which were greater than 100% equivalence of phosphate.

In the titrations of O.O2N solutions of zinc sulfate, zinc chloride and zinc nitrate with sodium orthophosphate the end points occurred at 100% equivalence of phosphate.

For the titrations of both cadmium and zinc salts with sodium orthophosphate rapid addition of phosphate favored end points higher than the theoretical. Pronounced minima were observed in the potentiometric curves. The amperometric end points became higher as the metal ion concentration decreased. Qualitative tests indicated the presence of phosphate in the precipitates.

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CHEMISTRY, ORGANIC

REACTIONS OF CYCLIC KETONES WITH AMINES AND SULFUR

(Publication No. 4912)

Ralph Peter Barone, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: MARVIN CARMACK

Horton and Van den Berghe have shown that 1-tetralone reacts with morpholine and sulfur to form 2-(N-morpholinyl)-naphthalene, a result totally unexpected from previous work with acyclic ketones yielding thioamides.

This dissertation describes the reactions of several cyclic ketones with secondary amines and sulfur. The results confirm the findings of Horton and Van den Berghe and in addition establish that the 2-position of the naphthalene ring becomes the point of attachment of the amino group (the possibility that it is the 3- position was left unsettled by Horton and Van den Berghe).

7-Methyl-2-(N-morpholinyl-naphthalene was prepared by the action of sulfur and morpholine on 7-methyl-2-tetralone. This compound was identified by a direct comparison with the product of a Bucherer reaction with 7-methyl-2-naphthol, morpholine, and sodium bisulfite. 6-Methyl-2-(N-morpholinyl)-naphthalene was also prepared by the reaction of 6-methyl-2-naphthol with morpholine and sodium bisulfite.

It was further found that pyrrolidine and piperidine could be made to react with 1-tetralone to produce 2-(N-pyrrolidinyl)-naphthalene and 2-(N-piperidinyl)-naphthalene, respectively. In addition to these, 7-methyl-2-(N-pyrrolidinyl)-naphthalene and 7-methyl-2-(N-piperidinyl)-naphthalene were prepared from 7-methyl-1-tetralone.

6-Methyl-2-(N-pyrrolidinyl)-naphthalene was

prepared by a Bucherer reaction with 6-methyl-2-naphthol, pyrrolidine, and sodium bisulfite.

2-Tetralone reacted with sulfur and piperidine or pyrrolidine to produce 2-(N-piperidinyl)-naphthalene and 2-(N-pyrrolidinyl)-naphthalene, respectively. When morpholine was allowed to react with 2-tetralone in the presence of sulfur, 2-(N-morpholinyl)-naphthalene and a minor second product was obtained. This minor product appears to have the formula $C_{14}H_{15}O_2N$. The ultraviolet absorption spectrum of this compound determined in a hydrochloric acid solution was similar to the curve for 2-naphthol; it also gave the characteristic bright red color of a 2-naphthol when coupled with benzenediazonium chloride. The structure tentatively proposed for this compound is 3-N-morpholinyl-2-naphthol.

When 6-methyl-2-tetralone reacted with morpholine and sulfur, only one product was obtained, and this was identified as 6-methyl-2-(N-morpholinyl)-naphthalene by a direct comparison with the synthetic compound previously described. This fixed the 2-position, the initial site of the carbonyl group, as the point of attachment for the morpholinyl group in the substituted naphthalene derivatives obtained in the 2-tetralone series.

The product of the reaction of cyclohexanone, morpholine, and sulfur was identified as p-phenylene-N,N'-dimorpholine by a direct comparison with p-phenylene-N,N'-dimorpholine prepared by a condensation of p-phenylene-diamine with two moles of bis (2-chloroethyl) ether. Similarly cyclohexanone was made to react with piperidine and sulfur to form p-phenylene-N,N'-dipiperidine. The synthesis of aryl-diamines by this method appears to be a new reaction.

1. Horton, W. J. and Van den Berghe, J., J. Am. Chem. Soc., 70, 2425-7 (1948)

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KINETICS OF THE REMOVAL OF BROMINE FROM ORGANIC MOLECULES AND IONS BY SILVER IONS AND BY THIOSULFATE IONS

(Publication No. 4905)

Wilson J. Broach, Ph.D.
University of Arkansas, 1953

Part A

KINETICS OF THE REMOVAL OF BROMINE FROM ORGANIC MOLECULES AND IONS BY SILVER IONS AND BY THIOSULFATE IONS

The reaction of silver nitrate with tetrabromophenolsulfonpthalein was studied at 25.1° and 30.1°. The reaction mechanism was found to be consecutive first order. The specific velocity constants, the energies of activation, the Arrhenius frequency factors, and the entropies of activation were determined for the removal of the first and second bromine atoms. The specific velocity constant for step 1 was found to be from 8 to 10 times as great as that for step 2. The rates of removals of the third and fourth bromine atoms from the dye molecules were shown to be negligibly slow. The negative entropy values were explained as due either to a rigid activated as compared to a reactant state or to a small transmission coefficient. Transmissions of the reaction mixtures were found to increase with time. This phenomenon was discussed at some length.

Part B

THE KINETICS OF THE REACTION OF THIOSULFATE ION WITH SODIUM BROMOMALONATE AND ETHYL BROMOMALONATE

The effect of changing the ionic strength and the effect of changing the dielectric constant on the reaction between thiosulfate ion and ethyl bromomalonate and between the thiosulfate ion and sodium bromomalonate have been studied. These reactions, which were found to be bimolecular, were used since they are free of side reactions.

This study is of especial interest since comparative rates of ion-ion and ion-dipole molecule reactions, when the reactants are very similar chemically, would thus be obtained and the effect of an ion change relative to a molecular dipole on kinetic data would be available. The rate of the ion-molecule reaction was found to be one hundred thousand times that of the ion-ion reaction. The reaction between the thiosulfate ion-sodium bromomalonate ion in a water solution was studied at 25°C. and at 45°C. It was found that the change in rate constant with changing ionic strength obeyed the requirements of the Bronsted-Christiansen-Scatchard equation with respect to direction but not with respect to magnitude. However, when the dielectric constant was varied by the addition of methyl alcohol, the rate constants did not follow the predictions of this equation. The solvent effect of the added methyl alcohol has a much greater influence upon the reaction rate than the electrostatic effect thus producing a divergence of data from theory.

The reaction of thiosulfate ion and ethyl bromomalonate was studied at 0.1°C. and at 25°C. The specific reaction rates for this reaction conformed to the prediction of the Amis-Jaffe equations with respect to changing ionic strength and conformed to the Amis equation with respect to changing dielectric constant.

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PART I. THE EFFECTS OF EXTRACTS OF SCOPARIA DULCIS ON ALLOXAN-DIABETIC RATS
PART II. THE SYNTHESIS OF DENDROASYMMETRIC COMPOUNDS

(Publication No. 4661)

Martin Jacobson Diamond, Ph.D.
Stanford University, 1953

PART I

In an extensive series of publications M. C. Nath of the University of Dacca, India, claimed to have extracted from the plant, Scoparia dulcis, an antidiabetic agent effective on oral administration. When this antidiabetic agent, "amellin," was administered to diabetic human beings in daily doses of 5 to 20 mg., high blood glucose, urine glucose, and urine volume were reduced, to normal values without regulation of diet, and there were no toxic effects.

As an attempt to substantiate these claims, extracts of dried Scoparia dulcis were fed to rats which had been rendered diabetic by injection of alloxan. Considerable difficulty was encountered in obtaining a colony of diabetic rats, because the difference between the lethal and effective dose of alloxan is small. However, the optimum dose of alloxan for rats was found by empirical methods to lie between 12 and 20 mg. alloxan per 100 g. body weight.

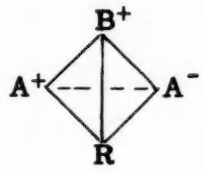
Extracts of Scoparia dulcis were prepared with hexane, methyl alcohol, and water, and mixed with Purina Fox Checkers. These mixtures then were fed to diabetic rats kept in metabolism cages so that food intake could be controlled rigorously, and 24-hour urine volume and urine glucose could be determined. The results indicated that the hexane and methyl alcohol extracts partially reduced the urine glucose and urine volume, but the water-soluble extract had no effect. However, in no case were the diabetic rats rendered normal again. Before a conclusive statement concerning the existence of an antidiabetic factor in Scoparia dulcis can be made, it would be desirable to test extracts from the fresh plant.

Supplementary experiments indicated that surplus vitamin B complex in the diet increased the urine glucose and urine volume in alloxan diabetic rats.

PART II

Dendroasymmetric compounds are substances that contain one or more dendritic centers, a dendritic center being an atom to which is attached three or four asymmetric groups. These compounds are of interest, since comparison of the optical rotations of dendroasymmetric diastereoisomers would provide further experimental evidence to test the van't Hoff principle of optical superposition.

In particular, compounds of types I and II should exist in two diastereoisomeric forms which would be different optical rotations despite the presence of identical groups in the molecules. As an approach to the synthesis of this type of compound methyl γ-methyl-γ-nitropimelate was prepared and condensed with dl-α-phenylethylamine to give γ-methyl-γ-nitro-N,N'-bis(α-phenylethyl) pimelamide. This product should exist as two meso forms in which one of the α-phenylethyl groups is (+) and the other (-), and a racemic form in which half of the molecules have both α-phenylethyl groups (+) and half have both groups (-). Two of these forms, designated A and B, were isolated as pure compounds by fractional crystallization, but the third isomer could not be obtained from the mother liquors.



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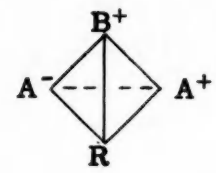

II

Isomer A, which was obtained most readily and in largest amount, was reduced to γ-methyl-γ-amino-N,N'-bis(α-phenyl-ethyl)pimelamide-A, and several attempts were made to resolve it in order to determine whether it was a meso or racemic form. It was possible to obtain a crystalline d-tartrate, but no resolution occurred within experimental error. Reduction of the B isomer of the nitro diamide gave a product from which no pure amino diamide could be isolated. Since the evidence for resolution of the A isomer was negative and the pure B and C isomers could not be obtained, no solution of the problem resulted.

In exploratory experiments to determine the feasibility of combining an asymmetric group with the amino group, γ-methyl-γ-dl-carbomethoxymandelylamino-N,N'-bis(α-phenylethyl)pimelamide-A was prepared by the reaction of the amino diamide with dl-carbomethoxymandelyl chloride.

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THE CHEMICAL REACTIONS OF o-NITROPHENYLDITHIOCHLORIDE AND THE SYNTHESIS AND ULTRAVIOLET ABSORPTION SPECTRA OF THE BIS-(o-NITROPHENYL) POLYSULFIDES

(Publication No. 4927)

John Ferguson Harris, Jr., Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: MARVIN CARMACK

PART I

THE CHEMICAL REACTIONS OF o-NITROPHENYLDITHIOCHLORIDE

o-Nitrophenyldithiochloride, , has been found to enter into reaction with many different types of compounds. The reactions in general parallel the corresponding reactions of the sulfenyl chlorides.

o-Nitrophenyldithiochloride was synthesized as described previously from o-nitrothiophenol and sulfur dichloride. An attempt was made to make it by cleaving acetyl o-nitrophenyl disulfide with one mole of chlorine at low temperature. The reaction did not proceed entirely in the desired direction.

o-Nitrophenyldithiochloride added to cyclohexene and stilbene to form β-chlorodisulfides. The adduct formed with 1,1-diphenylethylene spontaneously lost hydrogen chloride yielding a vinyl disulfide. The fact that hydrogen chloride did split out indicated the direction of addition of the dithiochloride. The dithiochloride reacted with ketene to form a compound which on hydrolysis yielded o-nitrophenyldisulfido acetic acid. The structure of this acid was confirmed by an alternate synthesis from thioglycolic acid and o-nitrobenzenesulfenyl chloride.

o-Nitrophenyldithiochloride reacted with acetone, acetophenone and α-tetralone presumably forming the corresponding β -ketodisulfides. Reaction also occurred between the dithiochloride and ethyl acetoacetate. In this case substitution occurred in the alpha-position. The dithiochloride did not react with ethyl acetate, 2-nitropropane and sulfones.

o-Nitrophenyldithiochloride substituted in the rings of several aromatic compounds. From phenol, p-hydroxyphenyl o-nitrophenyl disulfide was formed. The dithiochloride substituted in the 1-position of β-naphthol presumably forming the corresponding unsymmetrical disulfide. The reaction between anthracene and the dithiochloride yielded o-nitrophenyl 9-anthryl disulfide. This same compound was synthesized from 9-anthryl mercaptan and o-nitrobenzenesulfenyl chloride.

o-Nitrophenyldithiochloride reacted with ammonia and amines to form dithioamines. With an excess of ammonia, o-nitrophenyl-dithioamine was formed. If an excess of the dithiochloride was used in this reaction, bis-(o-nitrophenyldithio)-amine was the product. The dithiochloride reacted with p-toluidine and morpholine to form dithioamines. These dithioamines could be cleaved readily with anhydrous hydrogen chloride to the dithiochloride and the original amine hydrochloride. The dithiochloride did not react with phthalimide itself but entered into reaction readily with potassium phthalimide.

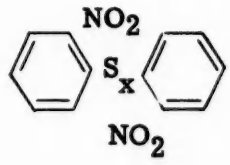
When o-nitrophenyldithiochloride was treated with an excess of potassium cyanide, o-nitrophenyl thiocyanate was formed.

o-Nitrophenyldithiochloride underwent several reactions in which sulfur sulfur bonds were formed. With hydrogen sulfide, bis-(o-nitrophenyl) pentasulfide was formed. This same pentasulfide was synthesized from o-nitrobenzenesulfenyl chloride and hydrogen trisulfide. When the dithiochloride was allowed to react with potassium iodide, bis-(o-nitrophenyl)-tetrasulfide was formed. The dithiochloride reacted with p-hydroxythiophenol and thioacetic acid to form p-hydroxyphenyl o-nitrophenyl trisulfide and acetyl o-nitrophenyl trisulfide respectively. When allowed to react with silver p-toluenesulfinate, the dithiochloride formed o-nitrophenyl p-toluenethiosulfonate.

PART II

THE SYNTHESIS AND ULTRAVIOLET ABSORPTION SPECTRA OF THE BIS-(o-NITROPHENYL) POLYSULFIDES

The bis-(o-nitrophenyl) polysulfides have been



(x=1,2,3,4,5)

synthesized and their ultraviolet absorption spectra examined.

The monosulfide and disulfide, both previously known compounds, were made by standard methods. The trisulfide, also previously known, was made by the reaction between o-nitrobenzenesulfenyl chloride and hydrogen sulfide. The tetrasulfide was synthesized from o-nitrothiophenol and sulfur monochloride. The pentasulfide was made by the reaction of o-nitrophenyldithiochloride and hydrogen sulfide.

The ultraviolet absorption spectra of the bis-(o-nitrophenyl) polysulfides bear a family resemblance to one another. Each curve is characterized by a broad and relatively intense band whose maximum lies in the region of 350 mu. This band, attributed to the o-nitrophenylthio chromophore, does not change significantly as the sulfur content changes. This indicates that there is probably little conjugation between the chromophores through the sulfur chain.

The absorption at shorter wave lengths (300-220 mu) is probably dominated by the absorption of the sulfur atoms. The bands in this region are broad, ill defined and consequently very difficult to analyse.

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DELTALINE, AN INVESTIGATION OF STRUCTURE

(Publication No.4928)

John Harvey, Jr., Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: MARVIN CARMACK

The presence of the alkaloid, deltaline, in Delphinium occidentale and in D. barbeyi has been confirmed. An improved method for its isolation and purification by chromatography has been developed. Analyses of the alkaloid, its salts, and its degradation products indicate an empirical formula of $C_{27}H_{41}O_8N$ for deltaline. An investigation of the functional groups of deltaline has made possible the expansion of the empirical formula to:

$$C_{19}H_{22}(>NC_2H_5)\ (-OCOCH_3)\ (-O\diagdown\ \ \diagup CH_2)\ (-O\diagup)\ (-OCH_3)_3(>O)$$

The alkaline hydrolysis of deltaline has been shown to yield an alkamine in which the acetoxy group of deltaline has been replaced by a hydroxyl group. The name deltamine has been proposed for this product of alkaline hydrolysis. A crystalline dihydrate of composition $C_{24}H_{39}O_7N \cdot 2H_2O$ has been isolated as the product of acid hydrolysis of deltamine. Formaldehyde is also produced during acid hydrolysis by cleavage of the methylenedioxy group. The hydrobromide of deltamine and the hydriodides of both deltamine and the acid hydrolysis product have been prepared for the first time.

The hydriodide of deltaline was prepared and was shown to be identical with the compound previously reported as deltaline methiodide by comparison of the melting points and the infra-red spectra. Similarly, deltamine hydriodide has been shown to be identical with the compound obtained in the reaction of methyl iodide with deltamine in methyl alcohol at elevated temperatures in a sealed tube. For this reason it has been found impossible to degrade deltaline or deltamine by either the Hofmann exhaustive methylation reaction or the Emde degradation with sodium in alcohol. Investigation of the von Braun cyanogen bromide reaction showed that this classical nitrogen degradation also failed, with deltamine or deltamine hydrobromide being the only products depending on the conditions.

The periodate oxidation of the acid hydrolysis product was investigated, and it was shown that two moles of periodate were reduced per mole of the acid hydrolysis product, suggesting that a 1,2,3-triol structure is present in the acid hydrolysis product and establishing a probable vicinal relationship of the acetoxyl and methylenedioxy groups of deltaline.

Deltamine has been oxidized by the Oppenauer method with abnormal results, suggesting the loss of one carbon and one oxygen as well as four hydrogen atoms. It is suggested that the product may be a diketone resulting from oxidation of the hydroxyl group of deltamine and a base catalyzed cleavage of the activated methylenedioxy group.

Deltamine was found to react with thionyl chloride, but the product isolated had lost the elements of hydrogen chloride and was characterized as dehydrodesoxydeltamine.

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A STUDY OF SOME IMIDAZOLE DERIVATIVES OF 1,4-NAPHTHOQUINONE

(Publication No. 4935)

John R. E. Hoover, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ALLAN R. DAY

A series of 4,9H-naphth(2,3)imidazole-4,9-diones was synthesized as compounds having potential biological activity and their chemistry was studied. Such compounds combine essential features of several classes of metabolites including the 1,4-naphthoquinone moiety found in vitamin K and other natural quinones and the aromatic imidazole structure which is found in a variety of natural products such as the purines and vitamin B_{12}. The 4,9H-naphth(2,3)imidazole-4,9-diones prepared included the free, 2-methyl, 2-ethyl, 2-n-propyl, 2-i-propyl, 2-n-butyl, 2-i-butyl, 2-n-pentyl, 2-diethylmethyl, 2-phenylmethyl, 2-morpholinomethyl, 2-piperidinomethyl and the 2-N,N-diethylaminomethyl derivatives. The dialkylaminomethyl derivatives possessed better water solubility than the other compounds prepared. The 2-substituted derivatives were synthesized starting with 2,3-dichloro-1,4-naphthoquinone (Phygon) by amination in alcohol to 2-amino-3-chloro-1,4-naphthoquinone followed by acylation with the respective acid chloride or anhydride using acid acid catalysis and subsequent amination in nitrobenzene to the corresponding 2-acylamino-3-amino-1,4-naphthoquinone. Ring closure to the imidazole was accomplished either by heating with alcoholic alkali or by reduction with zinc and acetic acid or hydrogen at atmospheric pressure using palladium black catalyst to the hydroquinone and heating the latter with acetic acid or dilute mineral acid. The unsubstituted 4,9H-naphth(2,3)imidazole-4,9-dione was prepared from 2-acetamido-3-amino-1,4-naphthoquinone by the action of ethyl orthoformate in the presence of sulfuric acid. Formylation of 2-amino-3-chloro-1,4-naphthoquinone was not accomplished. The method could not be applied to the preparation of 2-methyl-4,9H-naphth(2,3)imidazole-4,9-dione by substituting ethyl orthoacetate for the orthoformate. The physical and chemical properties of the 4,9H-naphth(2,3)imidazole-4,9-diones and their intermediates were discussed. These compounds separate from organic solvents as yellow needles and have relatively high melting points. They readily formed metallic salts and gave salts with

acids which could be hydrolyzed by the addition of excess water. Alkylation of the 1-position was accomplished using the sodium salts and alkyl sulfates. The imidazole ring was stable under acidic and alkaline hydrolytic conditions. Acylation of the 1-position could not be accomplished under acidic or basic conditions, and the Schotten and Baumann procedure did not result in ring opening. Reduction with zinc and hydrochloric acid, hydrogen and palladium black at atmospheric pressure and sodium hydrosulfite resulted in the colorless hydroquinones. The latter were oxidized by air to bright blue intermediates which gave the parent quinone on more vigorous oxidation.

Comparison of the ultraviolet and visible spectra of selected 4,9H-naphth(2,3)imidazole-4,9-diones and the intermediates leading to their synthesis led to a correlation of the unusual reactivities of these compounds with their structures. The spectra of the 4,9H-naphth(2,3)imidazole-4,9-diones closely resemble those shown by 1,4-naphthoquinone and tricyclic quinones such as anthraquinone and lin-naphthindazole quinones.

On treatment of 2-chloroacetamido-3-chloro-1,4-naphthoquinone with secondary amines (dimethyl, diethyl, di-n-propyl, di-n-butyl and morpholine) unexpected products were obtained. The reaction with diethyl amine resulted in 4-ethyl-2,5,10(1,3,4)naphtho(2,3)pyrazine-trione directly. The other secondary amines gave 2-chloroacetamido-3-dialkylamino-1,4-naphthoquinones which lost alkyl halide to form the corresponding 4-alkyl-2,5,10(1,3,4)-naphtho(2,3) pyrazinetriones upon heating in ethylene glycol or nitrobenzene.

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THE SYNTHESIS OF SUBSTITUTED 6-CHLORO-2-METHYLIMIDAZO-(b)-PYRIDINES AND OF 6-CHLORO-2-IMIDAZO-(b)-PYRIDYLCARBOXYLIC ACID AND ITS DERIVATIVES

(Publication No. 4945)

Florence Louise Meshkov, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ALLAN R. DAY

Modification of reported methods has permitted the preparation of 2-amino-5-chloropyridine from 2-aminopyridine in yields of up to 80 per cent. Improvements were effected by the substitution of cold anhydrous ethanol as the chlorination medium for previously used solvents, and the separation of by-products by the use of carbon tetrachloride.

The catalytic reduction of 2-amino-5-chloro-3-nitropyridine to 5-chloro-2,3-diaminopyridine has been modified to considerably improve previously reported yields.

6-chloro-2-hydroxymethylimidazo-(b)-pyridine was prepared by the fusion of 5-chloro-2,3-diaminopyridine with glycolic acid. A method for its conversion to 6-chloro-2-chloromethylimidazo-(b)-pyridine hydrochloride by a reaction with thionyl chloride was developed. This compound, which was an active vesicant, is a key intermediate for the preparation of imidazo-(b)-pyridine derivatives containing substituents in the 2-position, which are of great interest as potential antihistaminic agents.

6-Chloro-2-chloromethylimidazo-(b)-pyridine hydrochloride was condensed with morpholine, piperidine, and diethanolamine to give the corresponding 6-chloro-2-alkylaminomethylimidazo-(b)-pyridine derivatives in good yields. The composition of these compounds was verified by elemental analysis, and the course of the reaction was shown by identification of the resultant by-products. Condensation of 6-chloro-2-chloromethylimidazo-(b)-pyridine hydrochloride with primary amines was also investigated.

6-chloro-2-imidazo-(b)-pyridylcarboxylic acid was prepared by the oxidation of 6-chloro-2-hydroxymethylimidazo-(b)-pyridine. During the investigation of the properties of this compound, its extreme ease of decarboxylation was strikingly evident. For example, attempts to prepare ethyl 6-chloromidazo-(b)-pyridine-2-carboxylate by direct esterification, by reaction of the silver salt with an alkyl halide, and by ester interchange all resulted in decarboxylation to form 6-chloro-2-imidazo-(b)-pyridylcarboxylic acid with thionyl chloride yielded not the acid chloride, but rather a complex diketopiperazine derivative, formed by the loss of two molecules of hydrochloric acid from two molecules of the acid chloride. It was found that alcoholysis and ammonolysis of this diketopiperazine afforded the best method of preparing ester and amide derivatives of 6-chloro-2-imidazo-(b)-pyridylcarboxylic acid. Ethyl 6-chloroimidazo-(b)-pyridine-2-carboxylate, 6-chloro-2-imidazo-(b)-pyridylcarboxamide, and 6-chloro-2-(N-piperidyl)-carboxamide were prepared thus.

These derivatives of the imidazo-(b)-pyridine nucleus are of potential physiological interest.

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CHEMISTRY, PHYSICAL

THE ACID STRENGTHS OF THE PHENYLACETIC ACIDS

(Publication No. 4920)

Edward Fackenthal, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: MARY L. KILPATRICK

The work described in this dissertation was undertaken primarily for the purpose of testing a hypothesis set forth by H. O. Jenkins which accounts for the increasing strength of the phenylacetic acids solely as the result of the increasing number of resonance forms in the acid anion with the successive substitution of phenyl groups in the acid. Jenkins' hypothesis leads to a prediction of 25×10^{-5} the order of magnitude of the dissociation constant of triphenylacetic acid in water. A determination of the dissociation constant by a method suggested by Löwenherz involving the dissolution of the highly insoluble acid in a solution of a relatively strong base, in this case the cacodylate ion, yielded a result of 11×10^{-5}.

Measurement of the dissociation constant of phenylacetic acid relative to acetic acid, in water, by the colormetric and E.M.F. methods, gave results of 2.72 and 2.81 respectively, values agreeing fairly well with computations made from values reported in the literature. The dissociation constants of the three phenyl-substituted acetic acids, relative to acetic acid, were determined in the solvents methyl and ethyl alcohol by the colorimetric and E.M.F. methods, the average results expressed in logarithms being 0.249, 0.395 and 0.321 for the mono-, di- and triphenylacetic acids, respectively, in methyl alcohol, and, in the same order, 0.238, 0.363 and 0.236 in ethyl alcohol. These values also contradict Jenkins' hypothesis.

The results were examined in the light of various other current theories dealing with the dielectric constant effect, steric effects, the effect of anion solvation, dimerization, and the acid-strengthening increase of electrostatic potential at the proton due to the presence of the polar phenyl substituents. While no single factor or theory accounts for the observed order of strength, a combination of the influence of the dipoles introduced into the acid molecule upon phenyl group substitution and the stabilization of the anion by solvation could explain the order of acid strength.

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ELECTROLYSIS OF ALKALI METAL PHOSPHIDES IN ANHYDROUS AMMONIA

(Publication No. 4923)

John Martin Finn, Jr., Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: E. CHARLES EVERS

The main work done comprised the electrolysis of anhydrous liquid ammonia solutions of sodium dihydrophosphide ($NaPH_2$), potassium dihydrophosphide (KPH_2), and tetrasodium diphosphide (Na_4P_2). Attention was concentrated on the anode reaction as manifest in the quantities of nitrogen and phosphine evolved in relation to the amount of charge passed. In all the cases mentioned the quantity of nitrogen varied linearly with electricity passed; this variation was also linear for phosphine in the cases of the dihydrophosphides. However, the quantity of phosphine evolved as a function of Faradays of charge passed was non-linear with tetrasodium diphosphide. The form of this function was the most significant result of the research. In a second, exploratory portion of the study electrolyses were performed on hexapotassium tetraphosphide in liquid ammonia; sodium dihydrophosphide in pyridine, piperidine (attempt failed), and methyl amine; and lithium dihydrophosphide in methyl amine.

For the liquid ammonia electrolyses, within experimental error, six Faradays of electricity produced one mole of nitrogen. This was explained as due to the reaction:

$$8\ NH_3 = N_2 + 6\ NH_4^+ + 6\ e^- \qquad (1)$$

In the presence of dihydrophosphide ion the anodic ammonium ion was considered to react as follows:

$$6\ NH_4^+ + 6\ PH_2^- = 6\ NH_3 + 6\ PH_3 \qquad (2)$$

Reaction (2) is consistent with the experimental current-yield of phosphine and also with the previously known reaction between ammonium salts and dihydrophosphides in liquid ammonia.

For the tetrasodium diphosphide electrolyses it was necessary to propose a more complicated mechanism to account for the less simple shape of the phosphine curve. Before 50% equivalence little phosphine was evolved. The main processes going on in this region were considered to be the protonation of diphosphide species:

$$P_2^{-4} \overset{p}{=} P_2H^{-3} \overset{p}{=} P_2H_2^{-2} \qquad (3)$$

Earlier chemical work supported the existence of the stable species $P_2H_2^{-2}$.

Shortly after 50% equivalence the curve of phosphine evolution versus charge passed became vertical. This could only mean the occurrence of a chain reaction. The quantity of phosphine that came off was such that solvent was necessarily involved in the process. Thereafter, as data for electrolyses carried out up to full equivalence were considered the phosphine evolution rate diminished; at 100% equivalence about 60% of the phosphorus originally present had been volatilized as phosphine.

The four reactions below indicate the mechanism proposed to account for the observed phenomena:

$$P_2H_2^{-2} \xrightarrow{p} P_2H_3^{-1} \quad (4)$$

$$P_2H_3^{-1} + NH_3 = P_2H_4 + NH_2^{-1} \quad (5)$$

$$P_2H_4 + P_2H_2^{-2} = 2\,P_2H_3^{-1} \quad (6)$$

P_2H_4 decomposes yielding 60% of its phosphorus as PH_3 (7)

Equation (4) involves another protonation step similar to the two of Equations (3). Reactions (5) and (6) show how the tri-protonated species may react with solvent producing biphosphine species and finally double the original number of tri-protonated species. The chain thus formed is considered to be limited by the decomposition of biphosphine, Equation (7). While the decomposition step is not defined in detail it is known that such occurs when diphosphine is introduced into liquid ammonia.

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ECONOMICS

ECONOMICS, GENERAL

INCOME IN THE TENTH FEDERAL RESERVE DISTRICT: A STUDY IN ECONOMIC DEVELOPMENT

(Publication No. 4840)

Wilbur T. Billington, Ph.D.
University of Minnesota, 1952

Per capita income in the Tenth Reserve District was generally low relative to the national average throughout the thirties; in contrast, the decade of the forties was marked by a rather steady increase in the ratio of District per capita income relative to the national average. In large measure District income movements reflected the extreme variability of farm income. Unfavorable farm price-cost ratios combined with drought conditions throughout the Great Plains area resulted in low levels of farm income during the decade of the thirties. With the forties came the return of more adequate precipitation, favorable relative prices for farm products, and consequently higher farm incomes.

The improved income position of the District's inhabitants during the forties, however, was not solely a function of enhanced agricultural income. In part income growth was also the manifestation of a more productive economy—of a gain associated with an advancement in the stage of industrialization, that is, in the proportion of the labor force engaged in secondary and tertiary occupations. In nearly every District state nonfarm private income and, in particular, the manufacturing payroll components of total income expanded more rapidly than any other element of income between 1940 and 1950.

The major problem of the dissertation involves the testing of the hypothesis that, during the period of extensive national economic expansion in the forties, surplus agricultural labor served as a conditioning factor in the more rapid industrialization of the District relative to the United States. The hypothesis is an alternative formulation of that portion of the theory of economic development concerned with industrialization resulting from a favorable processing (wage) cost advantage within an overpopulated region. The contention is that labor availability itself, not particularly low wage rates, is the more significant factor during a period of extensive expansion. The testing procedure involves: (1) a consideration of the reasons for surplus farm labor in the District, (2) an account of the evidence of that surplus, and (3) an attempt to determine the extent to which the developments in manufacturing were related to excess labor.

In large measure the population pressure and surplus labor which developed in the District during the thirties were manifestations of oversettlement in the Great Plains area and the continued progress of farm mechanization. The drought years forcefully pointed out the lack of balance between the people and the land. Meanwhile mechanization was making it possible for a family to operate much larger acreages.

The evidences of surplus labor are contained in the data which depict the emigration from the District, the high rates of unemployment, and the low wage levels prevailing throughout the thirties and early forties. Emigration tended to reduce the magnitude of the labor surplus; nevertheless, the evidence indicates that an abundance of labor continued to exist.

The case for the proposition that surplus labor was actually a conditioning factor in the development of manufacturing rests upon two considerations. First, the most important inward shifts of wage jobs were made in a diversified group of industries characterized by high labor requirements and the processing of raw materials in which the District had no particular advantage. The reasoning is that under the pressure of tight labor markets in highly industrialized areas such industries sought to expand in regions of surplus labor. Second, limited direct evidence indicates that state and federal governmental officials, responsible individuals and civic groups, as well as some manufacturing firms viewed the abundance of labor in the District as an important factor in industrial expansion.

In appraising the validity of the hypothesis it must be concluded that it is tenuous. The weight of the evidence tends to support the thesis; yet the evidence does not offer convincing proof of its validity. It is felt that the work accomplished represents a sound first step toward a more thorough understanding of District industrialization.

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DEVELOPMENT OF AGRICULTURAL POLICY

(Publication No. 4845)

Arnold Brekke, Ph.D.
University of Minnesota, 1952

Operating in the arena of public or private policy is exceedingly difficult at this stage in the development of the social sciences. Economists encounter problems in policy inquiry at various levels. Valid ascertainment of objectives is currently impossible and evaluation of alternative methods of achieving stated policy goals is also fraught with difficulty. This thesis engages both these phases of policy inquiry. Analysis of the difficulties encountered by current methods of operation is followed by an attempt to overcome crucial obstacles to more effective professional operation in the field of policy.

Methods of ascertaining and formulating objectives of economic(social)policy are inadequate. This result is inevitable when goals are studied from the ethnocentric viewpoint of specialists. The almost inevitable result is disperspective, dichotomization, and oversimplification. Operating society is an integrated entity, interdependence, interrelatedness, and interaction are of the very essence of our civilization. The objectives of people reflect this holistic situation. This problem is further complicated by the inarticulateness of people vis a vis their own value structures. Specialized social scientists simply do not have the equipment whereby appropriate structures of policy objectives can be formulated.

The sum of economic, political, "social", and other objectives does not add up to a valid formulation of goals. Ends are cultural in nature. Objectives must be identified, ranked according to priority, and placed in a synthetic weighted perspective structure. This is only achievable through a process of synthetic teamwork among the social scientists and other students of human affairs. This type of joint operation is required to produce a complete social science which is the only type of science that can be validly applied to the problem of ascertaining policy objectives.

The problem of scientific evaluation of means cannot be validly separated from the consideration of ends. Ends and means are names for different viewpoints of the same process. They are separated here merely for the purposes of exposition. The social sciences in sum cannot at this stage validly formulate either ends or means and for the same reasons-the lack of a complete social science. Models of cultural efficiency must be available for valid evaluation of alternative policy programs. Collating the contributions of the various relevant disciplines is not sufficient. Synthesis is also required in this area. The efficiency of any economic policy cannot be comprehensively determined without a model of cultural efficiency. Our existing models of economic efficiency fall far short of this requirement.

The commonly employed model of optimum economic efficiency is the static, perfectly competitive, general equilibrium one. This model is conspicuously inadequate for failure to mesh organically within the total operating culture, i.e., it is externally inconsistent. It abstracts from vital areas of human experience of vital importance to comprehensive evaluation of alternative efficiency policies. Internally it violates and/or ignores some of the major economic realities of the day.

An adequate model of economic efficiency must be synthetically suffused within the matrix of overall cultural efficiency and each of its constituent parts must be so structured. It must occupy its proper niche within a valid theory of the total scheme of human affairs. It must specify the nature of the structure and operation of the economic constituents of the operating whole. It must specify the optimum structure and rate of economic growth in all its important manifestations. It must define the best type and extent of government participation in economic activity. The optimum distribution of income must also be specified with this context. The major part of this thesis is devoted to a construction of such a model.

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AN ANALYSIS OF THE SPAN OF CONTROL AND SELECTED COORDINATING AND CONTROL MEDIA EMPLOYED BY CHIEF EXECUTIVES OF OHIO MANUFACTURING COMPANIES

(Publication No. 4931)

James Henry Healey, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ROBERT P. BRECHT

This study is an analysis of the span of control used by chief executives and the techniques or devices employed in the supervision of the people comprising the span. The principal portion of the study consists of a survey of 620 Ohio executives: 445 chief executives of firms with headquarters in Ohio and 175 managers of branch plants located in the state.

The data presented in the study were gathered by conducting fifty personal interviews with chief executives of Columbus, Ohio manufacturing firms and by utilizing questionnaires to collect information

from the remainder. Prior to conducting the interviews and mailing the questionnaires, a survey of literature covering the span of control and the selected media of coordination and control was made. The results of that survey are presented in Chapters II and III of the study in order to provide the theoretical background for a comparison with the actual practices of the executives participating in the survey. Chapters V, VI, and VII of the study present the data gathered by interviews and questionnaires. Chapter VIII contains the conclusions of the comparison of practice with theory. Some of the more significant conclusions of the study follow:

1. The span of control in practice, as evidenced by this survey, tends to agree with the span advocated in theory. This span is from three to eight subordinates.
2. The chief executives of larger units tend to employ a higher span than those of smaller units. The higher span is caused by the presence of representatives of subsidiaries and staff specialists on the second echelon.
3. Higher spans are found in branch plants than in main plants. A reason for this is the more limited activities of the branch with the activities of several of the subordinates falling in the same functional area.
4. Production, sales, and finance functions report directly to the chief executives of main plants in substantially all of the firms participating in the survey. The next most frequently reporting functions are purchasing, engineering, and personnel, in that order.
5. In the branches, production and finance report directly to the manager in over eighty per cent of the branches surveyed. Personnel, engineering, and purchasing precede sales in frequency of occurrence.
6. Little agreement was evidenced in the survey for a high span as a desirable medium of forcing the executive to delegate authority and responsibility, or as a way to increase the morale of the immediate subordinates.
7. Executives with high spans are more apt to employ the following tools of management: written media for policy communication, reports, conferences, and committees.
8. Relatively little use is made in Ohio industry of policy manuals and staff assistants to the chief executive.
9. Oral methods of communication are favored over written media by Ohio executives. Memoranda and reports, however, are used in the assignment of authority and responsibility and as evidence of the discharge of this stewardship.
10. Committees and budgets are more widely used in branch plants than in main plants. Production and policy committees are the more commonly used committees.
11. Considerable reliance is placed upon promotion from within to fill executive positions. Newly appointed subordinates are usually trained by an on-the-job method, with personal supervision and frequent conferences the principal media utilized.
12. There appears to be little appreciation of the objective as a control device, since oral communication is commonly used both for an initial and the continuing transmission of the company objectives to immediate subordinates.

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THE CONCEPT AND MEASUREMENT OF BUSINESS INCOME FOR CORPORATE REPORTING

(Publication No. 4859)

Charles Ellicott Johnson, Ph.D.
University of Minnesota, 1952

The Problem

This study is concerned with the concept and measurement of income from the viewpoint of the large, publicly-held corporation. Corporate income serves many important functions; it is unlikely that any single concept of income will serve all of them satisfactorily. Reasons are developed for considering the function of business income as a tax base, as a component of national income measures, as a legal basis for dividends, as a criterion of price regulation, and as a basis for managerial decisions—all as uses of income which raise special-purpose issues not necessarily germane to the problem of business income for corporate reporting to outsiders.

The purpose of this study is to determine the concept of income which will best enable those outside the corporation to judge its past performance in diverting a stream of resources from the economy, and its prospects for the future.

The Analysis

The definition of business income adopted as a framework for this study is:

> Business income is the maximum amount (expressed in monetary terms) of the resources under the control of the business entity, which, if separated from that entity during a given period of time, would leave the corporation as well off at the end of that period as it was at the beginning.

The source of the major conflicts over concepts of business income lies in different meanings attached to various elements of this definition. Three fundamental issues are involved:

(1) What characteristic of the corporation should be

adopted as a basis for determining the "well being" of the corporation. It is concluded that this should be assessed in terms of the size of the corporate "residual estate", defined as the difference between its gross resources and the offsetting series of obligations which constitute restrictions against this gross estate in favor of non-residual claimants.

(2) What method of valuation should be used in determining the size of the residual estate and thus when and by how much the corporation is better off than before.

(3) What unit of measurement should be used in connection with the method of valuation adopted.

Issues (2) and (3) form the basis for a four-fold-classification of business income concepts for analytical purposes:

A. Money concepts of income - business income concepts which embody the assumption that money is of constant significance over time.
   a. "Recovery of monetary investment" concepts of income
   b. "Maintenance of monetary earning power" concepts of income

B. "Real" concepts of income - business income concepts which embody the assumption that the significance of money changes over time.
   a. "Recovery of real investment" concepts of income
   b. "Maintenance of real earning power" concepts of income

The present concept of income underlying the accounting process and various proposals to modify this concept are analysed within the above classification, and their relative merits considered in relation to the criterion established above.

Conclusions

A "recovery of monetary investment" concept of income is recommended as the primary basis for income determination and a method is outlined for classifying income so determined into two categories: the excess of revenues over "contemporaneous costs," defined as those costs which would have been incurred had the services expiring during the period been acquired at current period's prices; and the concomitant "price gain or loss," defined as the difference between contemporaneous costs and the actual investment in services which expired during the period.

It is urged that a measure of "real" income, based on the assumption that changes in the significance of money as a standard of value may be accounted for through the use of an index of the general price level, be presented as supplementary information in corporate reports.

Microfilm copy of complete manuscript of 249 pages, $3.11. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-362.

MEDICAL CARE THROUGH VOLUNTARY INSURANCE: THE HEALTH INSURANCE PLAN OF GREATER NEW YORK

(Publication No. 4904)

Jules Joskow, Ph.D.
Columbia University, 1953

During the past decade strong agitation has developed for expansion of our Federal social insurance system to include a program of compulsory health insurance. The economic and medical feasibility as well as the need for such a program has been subjected to such severe criticism, however, that there is little likelihood of its introduction in the near future. It is highly probable that the American people will witness instead a great expansion of our system of voluntary health insurance which has demonstrated remarkable growth in recent years.

In essence, most medical services in the United States are rendered by physicians, practicing as individuals, who are freely chosen by their patients and who are paid for their efforts on a fee-for-service basis. Most voluntary insurance plans in existence today are primarily designed to provide a means for aiding in the payment of part of these fees-for-service.

It is the thesis of this study that this system of medical care is subject to important diseconomies; that the type of medical care insurance ordinarily offered tends to perpetuate these diseconomies and generally provides inadequate protection against the risks involved; and that, under certain conditions, a program of voluntary medical care insurance can be devised which does much to reduce these diseconomies and at the same time increase the protection provided.

That such a thesis is tenable is demonstrated by an examination of the conception and experience of the Health Insurance Plan of Greater New York. This is, essentially, a case study in medical economics bearing most directly upon the problem of provision of medical care insurance as it affects the people of New York. The analysis is carried out, however, within the framework of the broader problem of the means through which medical care is provided and paid for.

The Health Insurance Plan of Greater New York is a non-profit, pre-paid medical care insurance plan that began to provide service to the people of New York in 1947. Its major characteristics distinguish it from most other plans for pre-paid medical care insurance. It provides comprehensive coverage. It provides service benefits rather than cash benefits. No limit is placed upon the amount of care rendered in any given illness. Participating physicians practice as members of medical groups, ordinarily operating from medical centers. Payments to medical groups are made on a capitation rather than a fee-for-service basis.

Analysis of the experience of the Health Insurance Plan of Greater New York demonstrates the economic and medical feasibility of the Plan. Most important, the Health Insurance Plan has demonstrated the

feasibility of several changes in the conventional method of distribution of medical care. It has shown that comprehensive coverage is compatible with the insurance principle and that provision of medical care through group practice and payment for that care by capitations are techniques which are not only feasible but are techniques which can result in benefits to both the patient and physician not generally available in "solo" practice on a fee-for-service basis.

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FRATERNAL LIFE INSURANCE

(Publication No. 4359)

Richard de Raismes Kip, Ph.D.
University of Pennsylvania, 1951

SUPERVISOR: C. K. KNIGHT

This thesis comprises 374 pages. There are eight chapters of text, a bibliography, and six appendices.

After an introductory chapter, there is a chapter discussing the concept of fraternal life insurance. Also in this chapter are presented data about the size of the institution of fraternal life insurance. Today the amount of life insurance in force in fraternal insurers is three per cent of that in force in commercial insurers. The number of certificates in fraternal societies is four per cent of the total number of policies in commercial companies.

Chapter III discusses the origin of fraternal life insurance. The generally accepted beginning was in October 1868, when Upchurch and others formed the Ancient Order of United Workmen in Meadville, Pennsylvania.

The study of a sample of 65 societies takes the next two chapters. The 65 divided into two large groups: 44 still in existence in 1948 and 21 no longer operating as fraternal societies at the end of 1948. Along with the data pertaining to the growth and decline of the societies, there is also presented information concerning the original rate bases and the changes made as time passed.

Chapter VI concerns itself with the fraternal insurance contract, which consists of the application for insurance and membership, the insurance certificate, and the charter and by-laws of the society presently in force and as they may be amended in the future. The fraternal certificate appears to be coming closer to the commercial contract in both form and format.

Chapter VII considers some other salient features of fraternal life insurance. The societies are exempt from taxation because they are charitable and benevolent organizations. Another feature getting attention is the field force. The extent of government supervision also comes in for consideration.

Chapter VIII is a summary chapter. It is perhaps appropriate to quote the last paragraph of the thesis:

> New conditions have wrought great changes in the fraternal insurance institution. The local lodge is no longer the important social center that it once was. In the early days it played an important part in the community life by bringing people together for various social benefits, particularly for amusement and recreation. Such services have been largely supplanted by the automobile, the motion picture theatre, the radio, and television. The local lodge has not been extinguished but it has certainly found the competition too great. Against this background the insurance protection still remains. It started with the assumptions that insurance need not cost much and that the fraternal ties would be priceless. Both assumptions have had to be altered. While the assessment principle has endured, the other principles associated with it have been entirely changed. The features found in its most vaunted competitor, the commercial insurer, have had to be adopted, despite the fact that the members had been educated to believe that these same features were costly, unneeded frills. It is remarkable that so many societies survived the period of change-over. The fraternal tie held many members; the need for insurance held others. The institution has been led from instability to stability, but not without a price. This price has been one of relying less upon the power of fraternalism, except in legislative and tax matters, and more upon adequate actuarial standards.

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A COMPARISON OF DAIRY CATTLE LABOR REQUIREMENTS FOR STALL AND LOOSE HOUSING BARNS

(Publication No. 4880)

James Allan Shute, Ph.D.
University of Minnesota, 1952

The objective of this study was to determine if and to what extent dairy labor can be saved by using loose housing in place of the stall barn. In order to fulfill that objective a review was made of the existing literature. Loose housing barns were observed and then data on labor requirements and working conditions were collected.

Survey data were collected for 33 loose housing barns and 21 stall barns. Fewer stall barns were included because there was less variability as to

type of organization among them. Also some data were available from other studies regarding stall barn operations.

Stop-watch timings were made in 24 loose housing barns and 20 stall barns to provide a basis for a more detailed analysis of the labor requirements under the two systems.

On the basis of the survey data for all of the farms included in the study the stall barn users required about 87 hours per cow per year compared to 72 for loose housing. On the basis of stop-watch timing of the smaller, more select group of farms the stall barn farmers used about 80 hours compared to 69 for loose housing.

If the least time consuming methods for doing the jobs under each system had been used the stall barn would have required 73 hours per cow per year compared to 55 for loose housing. Not only does loose housing require less labor at the present time but it appears that the system has a greater potential for future reduction of its labor requirement than does the stall barn.

Jobs which were common to both groups such as getting cows from pasture and spraying cows were omitted from these comparisons. It also was impractical to secure an estimate of the time spent at the many small odd jobs and "puttering" done in a typical dairy barn. Consequently the total hourly requirement as reported in this study is lower than those generally reported in other studies.

When experimental set ups and farms with unusual amounts of equipment were excluded from the comparison, milking in the stall barn required an average of 51 hours compared to 43 for loose housing. On the basis of a synthetic comparison an increase in herd size from 15 to 30 cows increased the time required per cow in the stall barn by increasing the average distance of travel per cow. With loose housing a similar increase in herd size had practically no effect.

Feeding cows required less time with loose housing because sweeping the mangers was eliminated and less travel was required.

Hay feeding required less labor with loose housing because the cows generally came to the hay to be fed. No portioning of the hay was necessary.

Silage feeding took about the same amount of time for the two methods of housing. However, one loose housing used fed his cows in considerably less time by throwing the silage directly from the silo into the bunk where it was fed.

Generally, loose housing required considerably less time per cow for manure removal. However, the stall barn with a mechanical barn cleaner required slightly less time per day than the most efficient method of manure removal in the loose housing barn.

Bedding cows required less time with loose housing than with the stall barn since it was unnecessary to loosen and respread straw in loose housing barns. There also were fewer obstructions in the bedded area than in the stall barn.

Miscellaneous work required less time in the loose housing barn. The cows did not need to be turned out for heat detection during the winter, there were no walks to be limed and the cows were not clipped or curried.

While it cannot be said that overall working conditions are better for either system it can be said that loose housing is safer for the worker. It also requires less physical stamina.

Microfilm copy of complete manuscript of 166 pages, $2.08. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-365.

THE STRUCTURE OF RETAIL TRADE BY SIZE OF STORE: AN ANALYSIS OF 1948 CENSUS DATA

(Publication No. 4954)

Paul A. Vatter, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: SIMON KUZNETS

The major purpose of this study is to describe the size distributions of the various types of retail stores and to determine, by statistical analysis, the relation between size and certain operating costs of retail stores. In order to study store size as a variable affecting retail operations, fifty-seven store types were analyzed for the Census Year of 1948. These store types included all retail establishments with the exception of department stores. Department stores were excluded from this analysis since by definition they did not afford a range of size variations comparable to that of the other store types.

The primary interest of this study is in the relationship between size (as measured by annual sales volume) and the cost elements of labor and investment in inventory. To investigate these relationships the following measures were obtained for every size class within each store type:

(1) Sales per full-time equivalent number of persons engaged in trade.
(2) The full-time equivalent number of part-time workers as a percentage of the full-time equivalent number of people engaged in trade.
(3) The ratio of the number of active proprietors to the number of equivalent full-time people engaged in trade.
(4) Sales per dollar payroll for corporate stores.
(5) The ratio of sales to average inventory.

The following general conclusions were reached:

1) Both labor productivity (sales per person) and payroll efficiency (sales per dollar payroll) showed a similar pattern of differences accompanying differences in size. In almost every line of trade the maximum value of these ratios occurred in an intermediate size class. As successively larger size classes were considered the ratios were successively larger up to that size class and thereafter were successively smaller.

2) Although most store types showed similar

patterns of differences in their ratios, the sales levels at which maximum productivity was obtained varied markedly among the lines of trade. The amount of difference in the ratios accompanying differences in size also varied considerably among lines of trade.

3) A comparison of the average stock turn in the various lines of trade indicated that the level of stock turn in the various store types is largely determined by the characteristics of the goods they sell.

Within lines of trade the rate of stock turn was higher in large stores than in small stores. Store types which primarily handle physically perishable products were an exception to this relationship.

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ECONOMICS, COMMERCE — BUSINESS

THE ECONOMICS OF MULTIPUMP FILLING STATIONS: SELECTED ASPECTS OF THE MINOR-BRAND MULTIPUMP MOVEMENT IN THE LOS ANGELES BASIN AND THE SAN FRANCISCO BAY REGION

(Publication No.4664)

Howard Vivian Finston, Ph.D.
Stanford University, 1953

Although the dynamic nature of multipump station operations does not permit a final evaluation at this time, nevertheless, several tentative conclusions are suggested by available evidence. Certainly, the superiority of multipump as compared with conventional station design has been amply demonstrated. On the cost side, multipump installations operated at a favorable volume level require lower initial investment, and allow both internal and external economies of operation. On the demand side, multipump outlets have achieved unprecedented consumer acceptance within a relatively brief period. Such competitive appeal is attributable, in large part, to the radical discount policies of minor-brand multipump operators, but also has been influenced by the spaciousness, physical attractiveness, and speed of service associated with multipump station construction.

When first introduced by multipump discount operators, policies of self-service were of promotional value in appearing to justify the existence of price discounts, and in promising more rapid purchase of gasoline. Contrary to prevailing popular opinion, however, the phenomenal profitability of multipump discount stations during the period 1947-1949 was not attributable primarily to the self-service feature. Although self-service tended to protect station owners against rising labor costs, the exceptional returns on investment were more closely correlated with high volume operations.

The initial competitive impact of the minor-brand multipump movement was reflected in the sales figures of conventional stations, and a growth in minor company market shares. Neither major-brand dealers nor major oil companies took action to meet the price competition represented by multipump discount stations until the minor-brand multipump movement had spread from its origin in Los Angeles and was flourishing in the San Francisco Bay Area and in the Sacramento Valley.

The first multipump discount stations, appearing in 1947, procured their supplies from local minor company refineries. As the movement progressed, an increasing proportion of gasoline sold by minor-brand multipump outlets was purchased from major company refineries. Although physically able to do so, the major companies failed to limit the growth of the minor-brand multipump movement by withholding supplies because of profits derived from wholesale sales to minor-brand distributors, and also because of competition among the major companies themselves.

More recently, a reduction in the price differentials between major-brand and minor-brand gasolines, coupled with the rapid building of major company multipump installations, have readjusted market share in favor of the major companies. The pre-1947 spread between major and minor company retail postings was restored in the Los Angeles Basin, through a lowering of major-brand prices, and in the San Francisco region, through an upward adjustment in minor-brand quotations. Whether the behavior of prices in the San Francisco area reflected independent market analysis, group action of distributors, or refinery policy can be answered definitively only by price policymakers. The contrast between price movements in the two areas cannot be explained by differences in station operating costs.

It is doubtful whether the potential economies of gasoline distribution through relatively few large-volume outlets will be realized in full by California consumers. Major and minor distributors are presently engaged in competitive building of multipump stations, the effects of which are evidenced in declining average gallonage per multipump installation, and attendant increases in station unit operating costs. Foreseeing the reemergence of station excess capacity, and apparent limitations upon aggressive pricing, many multipump operators have reduced the size of new stations to a point consistent with prospective demand, without relinquishing such basic multipump tenets as ease of entrance and exit, multiple pump islands, and functional simplicity. Thus, whereas the multipump movement has exercised a pronounced effect upon industry marketing operations during the past several years, economies which would derive from a fully rationalized system of retail distribution are not likely to be attained in the near future.

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EDUCATION, GENERAL

AN ANALYSIS OF CERTAIN COMMUNITY CHARACTERISTICS RELATED TO THE QUALITY OF EDUCATION

(Publication No. 4554)

Frederic Lyman Ayer, Ph.D.
Columbia University, 1952

I. Why Analyze Community Factors?

Research in the area of educational administration is still in a formative stage. Historical research and experimentation up to this time have identified to a limited extent the areas served by administrators, and have indicated certain goals. However, this foundation is still somewhat shaky, the direction of departure is not clearly pointed out, and even hypothetical directions of travel are difficult to determine.

The purpose of this study is to provide some base lines for research in that area of school administration dealing with the interrelationship of the school and the community. Earlier studies by Mort and Cornell[1,2] had made a selection of many measurable characteristics of a community which showed some relationship to the quality of schools and the potential of the community to provide good schools.

The some sixty measures identified by them were later reduced to twenty-four which showed statistically significant relationship to school adaptability by Pierce.[3] Pierce assumed that the ability of a school to adapt itself to changing conditions as measured by its tendency to adopt new educational practice was an ability that was nearly always found in conjunction with good educational quality. The terms "adaptability" and "school quality" are used interchangeably both in his study and in the present one.

The Pierce measures were grouped into three categories, logically, but not statistically determined, defined as: good will toward education, public understanding of what good schools can do, and factors which condition the expression of good will and understanding in the schools. The measures when grouped into these categories and correlated with the two measures of adaptability of the schools, The Growing Edge[4] and A Time Scale,[5] accounted for 64% of the variations among communities in adaptability.

This study uses the same raw data employed by Pierce and subjects it to centroid factor analysis, a process which for efficiency should have been followed prior to the Pierce study. Primary objective is to determine which of the Pierce measures are related to the same general factors, and to assay the Pierce factors as they have been hypothesized.

II. Methods and Procedure.

Those community characteristics which had a significant degree of relationship with scores on the Time Scale and The Growing Edge were intercorrelated for the thirty-three Metropolitan School Study Council communities for which all data were available or could be collected.

Through the Thurstone centroid method five factors were extracted. Factoring was stopped when the cell values in the residual matrix were all less than .05.

III. Conclusions.

The five factors appearing in Table I with their factor loadings seem to be factors of Wealth, Public Understanding or Intellectual Level, Urbanness or Centralization, Tax Structure, and Suburbanness or Rurality.

Factor I, in which the variable wealth is almost completely accounted for, seems to be self explanatory. More research is indicated in the remaining four factors in order to determine exactly what they are. They do provide a base for hypothesizing.

COMMUNITY CHARACTERISTICS
FACTOR LOADINGS

	Factor Loading
Factor I	
Wealth per pupil	.99
Expenditure per pupil	.88
Tax leeway	.76
Growing Edge	.58
Ratio of assessment	.37
Time Scale	.31
Wealth trend	-.47
Total tax rate	-.60
School tax rate	-.67
Factor II	
Percent of unskilled workers	.79
Percent foreign born	.44
Density	.31
Area	.48
Percent home ownership	-.46
Poll of Opinion	-.47
Growing Edge	-.48
Percent college graduates	-.49
Percent business and professional workers	-.87
Percent eighth grade graduates	-.95
Factor III	
Density	.80
Enrollment	.68
Time Scale	.60
Growing Edge	.50
Percent eighth grade graduates	-.29
Wealth trend	-.39
Factor IV	
Ratio of assessment	.72
Percent of foreign born	.34
Percent tax for debt service	.27
Percent college graduates	.26
Wealth trend	-.32
Percent fifty years and over	-.38
School tax rate	-.54
Total tax rate	-.67

Factor V	Factor Loading
Area	.45
Growing Edge	.31
Percent foreign born	-.26
Wealth trend	-.35
Density	-.53
Enrollment	-.54
Population	-.63

Percent of contribution to total variance is as follows:

Factor I	19%
Factor II	17%
Factor III	10%
Factor IV	9%
Factor V	8%

Variables for which most of the variance is accounted are these: Percent eighth grade graduates, 99%; Wealth trend, 99%; Total tax rate, 84%; Expenditure, 80%; Growing Edge, 95%; Density, 100%; Time Scale is 50% accounted for.

[1] Variables with loadings of less than .20 have been omitted from the tables for clarity in presentation. Based on data for 33 communities in the New York-Metropolitan area on 22 variables.

1. Paul R. Mort and Francis G. Cornell, Adaptability of Public School Systems, (New York, Bureau of Publications, Teachers College, 1938), p. 40.

2. Paul R. Mort and Francis G. Cornell, American Schools in Transition, (New York, Bureau of Publications, Teachers College, 1941).

3. Truman M. Pierce, Controllable Community Characteristics Related to the Quality of Education, (New York, Bureau of Publications, Teachers College, 1947).

4. Paul R. Mort, William S. Vincent, and Clarence A. Newell, The Growing Edge, (New York, Metropolitan School Study Council, 1946).

5. Paul R. Mort, Truman M. Pierce, A Time Scale, (New York, Metropolitan School Study Council, 1947).

Microfilm copy of complete manuscript of 39 pages, $1.00. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-368.

A STUDY OF UPPER CLASSMEN IN VOCATIONAL AGRICULTURE TO IDENTIFY CERTAIN FACTORS ASSOCIATED WITH THE LEVEL OF DESIRE TO REMAIN ON THE FARM

(Publication No. 4842)

Walter T. Bjoraker, Ph.D.
University of Minnesota, 1952

A random sample of 415 junior and senior students of vocational agriculture in the high schools of Minnesota and Wisconsin was studied to identify certain factors associated with their level of desire to remain on the farm. The purpose of this investigation was to secure basic information that will have implications for curriculum planning in the vocational agriculture program and in the guidance activities carried on with rural boys.

The data was collected through the use of tests, rating scales, and questionnaires. The information included: (1) the level of desire to remain on the farm, (2) the attitude towards farming, (3) the measured mental ability, (4) the socio-economic level, (5) the size of the family, (6) the formal educational level attained by the parents, (7) the tenure status of parents, (8) the size of the farm business in terms of productive work units.

The following instruments were employed in collecting the data: (1) the Henmon-Nelson test of mental ability, (2) Sewell's Socio-Economic Status Scale, (3) Myster and Wert's Attitude Toward Farming Scale, (4) a five point scale showing level of desire to remain on the farm, and (5) a farm and family background questionnaire.

Using the size of the high school vocational agriculture departments, the homogeneity of the variability and of the means was tested, and the sample showed no real difference existed between the sample and the parent population. Chi square was used to analyze the data, setting a five per cent level of significance. The corrected coefficient of contingency was determined for all significant chi squares. Yule's Q was calculated to determine the sign. The inter-relationships were analyzed, and the data was amenable to the use of the statistic, the Pearson Product Moment was calculated as a partial check on the coefficients of contingency. In considering farm ownership, the biserial correlation was used as an estimate of the product moment correlation.

The findings revealed there was a significant association between the following:

1. The boy's measured attitude toward farming, and his expressed level of desire to remain on the farm.
2. The size of the home farm in acres, and the boy's level of desire to remain on the farm.
3. The size of the farm business as expressed by the number of productive work units on that farm, and the boy's level of desire to remain on the farm.

In analyzing the data in relation to specific hypotheses, it was found that there was no significant association at the five per cent level between the following:

1. The measured mental ability and the level of desire to remain on the farm.
2. The socio-economic level of the farm family, and the level of desire of the boy to remain on the farm.
3. The size of the family, and the level of desire of the boy to remain on the farm.
4. The formal educational level attained by the parents, and the son's level of desire to remain on the farm.

5. Farm ownership by the parents, and the son's level of desire to remain on the farm.

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A STUDY OF SOME OF THE FACTORS THAT INFLUENCE THE SELECTION OF PUBLIC SCHOOL SUPERINTENDENTS AND HIGH SCHOOL PRINCIPALS IN MICHIGAN

(Publication No. 4495)

Gerald Bosch, Ph.D.
Michigan State College, 1952

This study was conducted to determine whether Michigan Boards of Education have developed effective plans, procedures and criteria to assist them in the selection of superintendents of schools and high school principals.

The information was gathered through the use of questionnaires, interviews, observations and wide reading in the field of educational administration and supervision. The questionnaire concerning the selection of superintendents was mailed to 556 Michigan Boards of Education; of this number 164, or 29.5 per cent, were returned and the results tabulated. A second questionnaire concerning the selection of public high school principals was enclosed for 494 superintendents. A total of 320, or 64.8 per cent, were returned, and the results tabulated.

The questionnaire on the selection of superintendents of schools was used as the basis of a personal interview with twenty-five members of Boards of Education in Michigan. These men were chosen for three reasons: (1) They had recently participated in selecting a new superintendent; (2) They represented different types of school districts; and (3) They represented geographic sections of the state.

Three main areas in the selection of school administration were identified: (1) The mechanics of selecting public high school administrators in Michigan; (2) The personal and professional qualifications desired in public high school administrators; and (3) The present thinking in Michigan concerning the administrative certificate and the internship program for school administrators. The personal qualifications which were rated highest include: (1) The administrator's ability to work well with others; (2) His personal integrity; (3) His ability to foresee the needs of both the school and the community; (4) His ability to inspire faith in educational goals; (5) His personal initiative; (6) His ability to make prompt and careful decisions, and (7) His personality. Included among the highest ranked professional qualifications were: (1) The ability of the administrator to enlist the cooperation of teachers; (2) His ability to recruit and select teachers; (3) His ability to handle a school budget; and (4) His ability to get things done efficiently.

The two major recommendations were: (1) That Boards of Education should invite lay and professional help in determining the qualifications, duties and responsibilities of the educational leader before employing him; and (2) That the administrative certificate be adopted in Michigan as a means of raising standards in the profession of school administration.

Other recommendations were: (1) That Boards of Education prepare written statements concerning educational conditions in the school and community for the benefit of applicants; (2) That greater participation be offered the classroom teacher in the selection of public school administrators; (3) That the role of the placement officer in the selection of school administrators be thoroughly studied; (4) That an effective internship training program in school administration be organized and implemented in Michigan; (5) That the importance of the public relations program be emphasized in the preparation and training of school administrators; (6) That Boards of Education give serious thought to the payment of expenses of applicants invited for interviews with the Board; (7) That Boards of Education make a practice of visiting communities where administrative candidates have been or are being employed; and (8) That Boards of Education employ school administrators only upon unanimous vote.

Microfilm copy of complete manuscript of 240 pages, $3.00. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-370.

THE CONSTRUCTION AND VALIDATION OF A TEST TO MEASURE SOME OF THE INDUCTIVE ASPECTS OF SCIENTIFIC THINKING

(Publication No. 4713)

Mary Alice Horswill Burmester, Ed. D.
Michigan State College, 1951

The purpose of this study was to devise a valid test to measure some of the inductive aspects of the ability to think scientifically, in the area of biological science. The educational objectives related to scientific thinking were formulated and were defined in terms of desired behaviors involved. In all, 98 behaviors were recognized as attending the critical, as opposed to the creative, aspects of scientific thinking. Nine tryout tests, consisting of a total of 637 items were constructed to evaluate these behaviors. These tests were administered during the spring term of 1950 to 168 students taking the third term of the three-term sequence of Biological Science at Michigan State College. Item validity and item difficulty were calculated for each item of the tryout tests.

Test I, The Ability to Think Scientifically, constructed from discriminating items of the tryout tests, consisted of 150 items. Test I was administered in the spring of 1950 to 500 students at the end of the three-term sequence of Biological Science, and in the fall of 1950 to another group of 240 students

who had had no college biology. The reliabilities of the test for the two groups were .89 and .91 respectively. Because Test I proved too long, 25 of the poorer items, as identified by item analysis, were eliminated. The remainder constituted Test IA, The Ability to Think Scientifically. This test was administered in the fall of 1950 to 330 students who had had no college biology, and to 136 of these same students after completion of one term of Biological Science. The reliabilities for the two groups were .91 and .90 respectively.

The curricular validity of the test was established by:

1. Designing the test items to measure the behaviors involved in scientific thinking.
2. Submission of the tryout tests to competent judges for criticism.
3. Using free responses of students as items wherever feasible.
4. Careful selection of materials utilized in the construction of the test items.

Three general methods were used in the statistical validation of the test, namely,

1. Scores made on the test of the ability to think scientifically were correlated with measures of intelligence, of reading ability and of knowledge of biological facts. These correlations ranged from .33 to .51.

2. Mean scores made by students who had had no college biology were compared with mean scores made by students who had had Biological Science. The means of those having had Biological Science were significantly higher.

3. Scores made on Test IA by 143 students were compared with ratings of these students by their instructors on their ability to think scientifically. The chi-square test, a comparison of means of students receiving superior, average and inferior ratings, and a correlation of scores on the test with the ratings all gave evidence of the statistical validity of the test. The correlation between scores on the test and the ratings of the instructors was .77 for the test when administered as a pretest, and .72 when administered as a post-test.

Microfilm copy of complete manuscript of 422 pages, $5.28. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-371.

EFFECT OF VITAMIN AND MINERAL SUPPLEMENTATION ON ACADEMIC ACHIEVEMENT

(Publication No. 4627)

William Herbert Creswell, Jr., Ed. D.
Stanford University, 1953

The purpose of this study was to investigate the effect of multiple vitamin and mineral supplementation on the academic achievement of male and female subjects at the freshman and sophomore secondary school levels.

Two hundred and twenty-eight subjects in a California high school were selected and organized into three parallel and equivalent groups. Group equivalence was established on the basis of two criteria: pre-test scores, and analysis of the subject's curriculum.

Form A of the Progressive Achievement Test — Advanced Battery (the measure of academic achievement) was administered as a pre-test. The three groups were then differentially treated over a sixteen-week period as follows: Group I received daily multiple vitamin and mineral supplementation; Group II received daily multiple vitamin and a placebo supplementation; Group III (control) received two placebo "supplementations." At the conclusion of the experimental period, Form B of the Progressive Achievement Test — Advanced Battery was administered as a post-test to all subjects, and mean gains for each group, based on total test scores, were computed for each group. Male and female subjects were treated separately because of a difference in amount of supplementation.

Differences among mean gains of the three groups were tested by Fisher's "t" technique. No differences significant at the .01 level were found.

Microfilm copy of complete manuscript of 77 pages, $1.00. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-372.

A STUDY OF WITHIN-TERM MALE DROP-OUTS AT MICHIGAN STATE COLLEGE FOR THE SCHOOL YEARS 1947-'49

(Publication No. 4705)

L. Dale Faunce, Ed. D.
Michigan State College, 1952

This investigation was undertaken to identify and describe attributes of within-term college drop-outs during the freshman and sophomore years, and to interpret the relationship of these attributes to the over-all functioning of a student personnel program at the college level. Specifically, the problem is concerned with describing the differential statuses of drop-out students at the time they leave school and the reasons they give for leaving.

Two primary sources of information were used in this study. Official records from various student personnel offices at Michigan State College were made available and provided a basis for collecting data pertinent to the personal-social background of the within-term drop-outs and the conditions under which this behavior occurred at the time of withdrawal. A second source of information was the drop-out student in person after at least one year had elapsed since the time of his withdrawal. Information was obtained from these former students by means of a questionnaire which had been checked for both validity and reliability by means of several criteria, including judges, trial runs, and interviewing. The records of all male freshman and sophomore students withdrawing from Michigan State College

during the terms of years 1947-49 were used for analysis.

The study revealed that within the college community the potential within-term drop-out fails to participate on a par with others in campus organizations. The requirements of academic discipline are more of a casual anchoring point for him, while his housing, health, personal matters, and finances stand in the foreground. The important values, the values about which he is concerned in either a positive or negative frame of reference (either for or against but in either case primary objects of attention and evaluation), serve as diversions from meeting the prerequisites of social and academic participation in the college as a community of interacting persons with mutual and reciprocal role expectations.

As a further index for potential within-term drop-out behavior the study also revealed that, (1) Off-campus housing presents the student with a financial dilemma, real or imaginary, which makes it difficult for him to maintain his student status and carry out his role obligations in the college community, (2) Poor academic work is acknowledged by students as a reason for their withdrawal only when some other reason is lacking, i.e., as a last resort, (3) Students who consider illness, finances, or employment as reasons for withdrawal will be functioning academically at the same level as students who recognize academic difficulty as their reason for leaving, (4) Private homes or temporary housing afford a condition associated with the concept of illness as a reason for withdrawal in direct contrast to dormitories, cooperatives, or fraternities, where the concept seldom emerges, and (5) The student who does well on entrance examinations is less likely to give illness as a reason for withdrawal than the student with average or poor performance on these examinations.

Microfilm copy of complete manuscript of 139 pages, $1.74. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-373.

AN EXPLORATORY STUDY OF THE ACTION-TYPE RESEARCH PROJECTS AS A PHASE OF THE MASTER OF EDUCATION PROGRAM (1945-51) IN THE COLLEGE OF EDUCATION OF THE UNIVERSITY OF GEORGIA

(Publication No. 4910)

Claude Moore Ivie, Ed. D.
Florida State University, 1953

Exploratory efforts were made in this study to determine the effectiveness of the action-type research projects in improving school and community living in Georgia.

Pressing school and community problems in Georgia were attacked through projects which sought the participation of people in the problem-solving process. The effectiveness of the projects and the permanency of the results were assumed to be increased if the people shared in the planning, executing and evaluating phases of attacks upon the problems.

The goals of the schools in Georgia seemed to be those of the community-type school. Cooperative problem-solving through the use of the project was identified as action research. Similarity of the purposes and procedures of the community-type school and of action research was cited from educational literature. It was postulated that action research develops the community-type school. Fifteen criteria were indicated which could be used to evaluate action research in the community-type school.

A basic questionnaire which sought data concerning the effectuation of projects was designed and sent to persons who had completed projects. A check-up questionnaire was utilized to determine the effect of projects completed at project sites from which project participants had moved.

Based upon certain selected variables, a sampling of twenty-seven project sites was chosen for visitation. Interviews were held with selected persons at the project sites, with University faculty advisors of projects, and with State Department of Education personnel.

Evidence from questionnaires, visitations, and interviews indicated that when the involvement of people in the action-type research project was extensive, the cooperative spirit desired in the community-type school was increased.

In schools and communities in which action-type research projects were conducted, improvements of school and community living were initiated and developed. The effectiveness of action-type research projects in initiating and developing programs of improved school-community living was directly proportional to the involvement of the people in all phases of the action research process.

Most project participants who stayed in the same schools and communities in which the initial projects were conducted indicated that the projects have continued in effect or have improved through practice. In schools and communities from which project participants had moved since completing the initial projects, over half of the projects were reported to have been continued or to have had a beneficial effect on the improvement of school-community living.

Persons completing action-type research projects had continued to use the action research process in that they had attempted additional projects.

Data was strongly indicative, though not conclusive, that certain variables affected the success of the projects. These variables were as follows: (1) the extent of the effort to involve people in all phases of the project; (2) the quality of the leadership in the school and community; (3) the depth of the problem attacked; (4) intensity of conviction on the part of project participants that the people in the school and community could cooperatively solve their problems; (5) the experiences of the people in cooperative attacks upon concrete and abstract problems; (6) the cultural backgrounds of groups that should have been involved.

Variables which had no determinable influence on the effectiveness of projects were: (1) years in which projects were completed; (2) problem areas with which projects dealt; (3) geographic location of projects as

to urban or rural areas; (4) distance of project site from the University of Georgia; (5) size of school; (6) supervisory visits as now conducted by University personnel.

It was concluded: (1) that action-type research had contributed to the achievement of the community-type school in Georgia, and (2) that action-type research projects had contributed and were continuing to contribute to the improvement of school and community living in Georgia.

Microfilm copy of complete manuscript of 368 pages, $4.60. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-374.

AN ITEM ANALYSIS TECHNIQUE BASED UPON ADJACENT GROUP DIFFERENCES

(Publication No. 4706)

Robert Arthur Jackson, Ed.D.
Michigan State College, 1952

The major purpose of this study was to present and evaluate a new item-analysis technique applicable in situations where the primary interest is in the discrimination between the members of two or more groups, rather than discriminating between the members within groups. This type of problem occurs frequently in assigning letter grades and in selection work where individuals are to be divided into two groups (that is, those who may be expected to succeed and those who may be expected to fail in a particular situation). A procedure for computing the adjacent-group item-validity indices were presented. This adjacent-group technique resulted in a maximized ratio of between-groups variance to total variance.

It was assumed in this investigation that the test-score distribution should be the one best fitting the need of the particular situation where the test is to be used. In the case of two groups, the most discriminating test was found to be one that yields a score distribution with a point of partition at the abscissa of the minimal ordinate between the two group modes. A theoretical examination of the score distribution for two groups showed that a non-overlapping bimodal distribution may be obtained by selecting a sufficient number of appropriate items. In the theoretical comparison of the bimodal test-score distribution with a normal test-score distribution, it was demonstrated that the bimodal distribution resulted in fewer chance errors than the normal distribution. In the case of more than two groups, the distribution should have points of partition at the abscissa of the minimal ordinate between any two adjacent-group modes.

The empirical findings of this study indicated that the selected test items tended to be stable under cross-validation. The empirical studies on the error of measurement of the multimodal test-score distribution also showed this error to be minimal at the points of partition separating two adjacent groups; the tendency seemed to be that the error of measurement approaches zero at the points of partition. These findings were interpreted in terms of the small number of cases involved in the data.

Since test items discriminating perfectly between two adjacent groups are difficult to obtain, it is quite apparent that the adjacent-group technique for the selection of items is used to greater advantage in situations where a large source of test items is available. However, the adjacent-group technique can also be applied in situations where intra-group comparisons are to be made and the source of items is more limited. This technique was found to be as satisfactory as Horst's more laborious technique of maximizing function in the selection of the most valid items in terms of an external criterion. It was found to be superior to the technique of Flanagan.

Microfilm copy of complete manuscript of 56 pages, $1.00. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-375.

AN ANALYSIS OF CERTAIN SCHOOL-LIFE MATURITY TRAITS OF THE SEVEN-YEAR-OLD

(Publication No. 4899)

Frederick Murl King, Ed.D.
Bradley University, 1952

The purpose of this investigation has been to discover certain maturity traits of the seven-year-old child, and (1) to ascertain to what extent they are present in a public school setting, and (2) to see if recommendations for improving the teacher's understanding of her pupils can be brought about through an analysis of these traits.

Comprehensive studies were made of thirty-three children in the second grade at Thomas Jefferson School in Peoria, Illinois. The data for the study of these children were gathered through the following various instruments of measurement: sociograms, achievement tests, teacher observations, child interviews, readiness tests, personality tests, and affectivity interview blanks.

Data pertaining to twelve "school-life" traits were secured. The traits that were used in this study have been set down by Dr. Arnold Gesell, Yale University, as points of departure and not as absolutes. They are:

1. Status Quo Trait.
2. Trait of Independence.
3. Trait of Fatigue.
4. Desire to Display Trait.
5. Trait of Accumulation.
6. Number Writing Trait.
7. Coin Naming Trait.
8. Counting Trait.
9. Trait of Reading Differences.
10. Attitude Toward Teacher Trait.
11. Before Breakfast Reading Trait.
12. Group Interplay Trait.

The above descriptive names of the original traits

were determined by this author. The traits as listed by Dr. Gesell with an accompanying discussion are found in Chapter I.

The data were analyzed as they related to each trait. The extent to which each trait was present with this group of children is discussed in Chapter VII. Recommendations for the teacher's use of Gesell's maturity traits and marginal findings are also presented in the concluding chapter.

Microfilm copy of complete manuscript of 201 pages, $2.51. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-376.

THE DERIVATION AND APPLICATION OF THE PRINCIPLES OF THE WORLD WAR II PHYSICAL RECONDITIONING PROGRAM TO THE UNIVERSITY PROGRAM

(Publication No. 4547)

Matt L. McBride, Ed.D.
New York University, 1952

The Problem

The problem is to derive, validate, and apply the principles of the programs of World War II physical reconditioning to the university program.

The Method of Investigation Followed

1. Determining the sources of the literature.
2. Establishing a plan for the organization of the principles.
3. Selecting and developing the principles.
4. Validating the application of the principles.

The Findings

As a result the findings of the investigator are:

1. The literature consists of both civilian and military sources.
2. The principles were developed according to five major groups. These groups are:
   (1.) The objectives of the program.
   (2.) The organization and administration of the program.
   (3.) The program of activities.
   (4.) The leadership phase of the program.
   (5.) The evaluation phase of the program.
3. Thirty-one principles were derived. These principles are as follows:

Group I. The Principles Which Relate to the Objectives of the Program.
1. The principle of maintenance.
2. The principle of acceleration.
3. The principle of restoration.
4. The principle of psychological readjustment.
5. The principle of physical fitness for civilian life.

Group II. The Principles Which Relate to the Organization and Administration of the Program.
6. The principle of classification.
7. The principle of determining the onset of convalescence.
8. The principle of patient identification.
9. The principle of examination and reclassification of patients.
10. The principle of general medical diagnosis.
11. The principle of patient orientation.
12. The principle of caring for and selecting equipment.
13. The principle of scheduling activities.

Group III. The Principles Which Relate to the Physical Reconditioning Program of Activities.
A. The remedial exercise program.
14. The principle of medical diagnosis.
15. The principle of "why and how".
16. The principle of muscle atrophy.
17. The principle of range of motion.
18. The principle of disability groups.
19. The principle of therapeutic value of exercises.
B. The Conditioning Exercise Program of Activities.
20. The principle of physiological tolerance.
21. The principle of alternation.
22. The principle of the conduct of the program.
23. The principle of program uniformity and content.
24. The principle of gradual progression.
25. The overload principle.
26. The principle of "set drills."
27. The principle of anatomical and physiological differences.
C. The Adapted Sports Program of Activities.
28. The Principle of selecting a program of adapted sports.
D. The Aquatic Therapy Program of Activities.
29. The principle of selecting a program of therapeutic aquatics.

Group IV. The Principle Which Relates to the Leadership Phase of the program.
30. The principle of the personal qualities of leadership.

Group V. The Principle Which Relates to the Evaluation Phase of the Program.
31. The principle of program evaluation.

4. According to the rating given by the jury of ten leaders the thirty-one principles were found to apply in varying degrees to the university physical reconditioning program as follows:
   (1.) Twenty-five principles were rated in the first category of importance.
   (2.) One principle was rated in the second category of importance.
   (3.) Two principles were rated in the third category of importance.
   (4.) Two principles were rated in the fourth category of importance.
   (5.) Two principles were rated in the fifth category of importance. (Do not apply at all.)

5. The reliability of the jury ratings was found to be r = .87 which according to current standards is considered to be acceptable.

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AN EVALUATION DEVICE FOR PROFESSIONAL PREPARATION OF RECREATION PERSONNEL

(Publication No. 4551)

William James Tait, Jr., Ed.D.
New York University, 1952

Purpose

To identify those basic concepts regarding the process of professional preparation agreed upon at national conferences, and to create a device that will show strengths and weaknesses of schools in their programs of professional preparation of recreation personnel on the undergraduate level.

Procedure

In this study the needs of people, trends in recreation, and needs of recreation leaders were developed by an exhaustive search of the pertinent literature.

The present status of professional preparation of recreation leaders was obtained by questionnaire whose format and scope were formulated by the investigator; then circulated to all colleges or universities offering professional preparation of recreation personnel.

Using the background of needs of people and needs of recreation leaders along with pertinent literature in the field and the format dictated by present status of professional preparation, the investigator developed a series of one hundred and eight criteria in five areas concerned with the process of professional preparation of recreation personnel on the undergraduate level. These five areas are: (1) organization and administration; (2) facilities; (3) students; (4) curriculum; (5) faculty. These criteria were submitted to two juries composed of leaders in the field of recreation for their comments. After additions and deletions, a rating scale, and the addition of a few clarifying statements under each criterion, two copies of the criteria were submitted to all the schools for their application and comments.

At this time, the schools were asked to apply these criteria and clarifying statements to their local situations and rate themselves as they felt they measured up to their idea of their own possibilities. There are no national standards by which each school may guide its evaluation. The schools were asked to return one schedule and their comments. The returned schedules were processed to determine reliability, consistency and an appraisal of each school's strengths and weaknesses was returned to them.

Conclusions

In applying the schedule to forty-one schools out of sixty-six answering the present status questionnaire claiming programs of professional preparation of recreation personnel on the undergraduate level, twenty-nine returned the schedules and twenty-seven returned their reaction to the investigator's evaluation of their strength and weakness. Eighty-seven percent agreed with the evaluation and indicated they considered the schedule a valid instrument for indicating strengths and weaknesses of the recreation curriculum after applying the schedule to their schools. Eight percent felt the schedule not applicable and five percent did not agree with the investigator's evaluation.

In applying the schedule it was found that most of the criteria were applicable to all schools. The greatest number of criteria marked as non-applicable was twenty-two by one school. One-half of the schools marked less than four criteria as non-applicable.

The criteria identified, agreed upon, and contributed by all schools represent a detailed implementation of basic concepts concerning the process of professional preparation of recreation personnel. These criteria are of high validity because they represent the combined ideas and thought of a great many recreation leaders located over the country.

The range of total points of the twenty-nine schools extended from four hundred twenty-eight to five hundred forty with five hundred forty being the highest possible score. The main value of this evaluation schedule lies in its use as a tool for a self-appraisal. There are no written standards for comparison, therefore each evaluation must represent the evaluator's opinion of the position the school occupies compared to the position the school is capable of assuming.

Microfilm copy of complete manuscript of 278 pages, $3.48. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-378.

DESIGN IN INDUSTRIAL ARTS: A STUDY OF CREATIVE MODERN DESIGN AS IT RELATES TO THE TEACHING OF INDUSTRIAL ARTS

(Publication No. 4887)

Robert Alan Tinkham, Ph.D.
University of Minnesota, 1952

In recent years, the "art" aspect of industrial arts has been decidedly neglected. This is readily apparent to anyone familiar with typical shop projects and with industrial-arts literature in general. The study "Design in Industrial Arts" recognizes this fact and attempts to analyze modern industrial arts and modern design philosophy for a possible solution to the problem.

The study attempts to analyze design training in secondary school shopwork in the light of modern theories of design and accepted concepts of modern

education. The overall purpose of the entire study has been to make learning in industrial arts more effective and meaningful.

In approaching the problem an extensive review of the literature served in developing a frame of reference for a discussion of industrial-arts design training. This included a study of philosophy and practices in three major areas: modern education, modern design and industrial arts. Concurrently with this review, two questionnaires were designed and submitted to two groups of individuals in industrial arts; first, heads of industrial-arts teacher-education departments and second, typical industrial-arts instructors in the three states of Minnesota, New York and Utah. Following this, a suggested method for teaching design in the school shop was developed as a guide for industrial-arts teachers and teacher educators.

From the time of the early beginnings of the school shop movement in the latter part of the nineteenth century there has always been some interest in design and some feeling of responsibility for the teaching of it. In the ensuing years design in the industrial-arts area has been conservative and seldom has been current with art education theories and practices. With few exceptions there has been a decided tendency to rely on academic approaches to design using rules and formulas for solving design problems.

Judging from the results of the study most industrial-arts teachers are at a loss as to how to teach design. Few of the teachers questioned have sensed the potentialities inherent in teaching modern design — the rich possibilities in problem solving, critical thinking, and creative expression.

Industrial-arts teacher-educators showed more concern for the development of creativity in the learner. Both groups, however, felt that published materials on industrial-arts design and project plans in the field as a whole leave much to be desired.

For maximum pupil growth — creatively, intellectually and emotionally — actual experiences in project designing should be encouraged. The method presented in the study capitalizes on the pupil's ability to advance beyond the rote-learning level. It places a premium on his skill in analyzing the function of an object, on his ability to do research suitable to his level and on his improvement in thinking through a design problem starting with the need for the object and finishing with the completed project.

With the study findings as guides, recommendations for further action include the following:

1. Industrial-arts design in its entirety should be reanalyzed in the light of today's design philosophy.
2. The industrial-arts field should terminate its present policy of giving lip-service to the improvement of design and at the same time fostering poor design through published materials.
3. Industrial-arts design needs to be taken out of the realm of the superficial and should be seen in its true role as a vital element in producing efficiency, comfort, and greater enjoyment in living.
4. The lack of valid research on industrial-arts design should be remedied by many studies exploring various aspects of the problem.

Microfilm copy of complete manuscript of 391 pages, $4.89. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-379.

EDUCATION, ADMINISTRATIVE

THE ADMINISTRATION OF PUBLIC SCHOOL SALARY SCHEDULES IN SELECTED CITIES IN CALIFORNIA

(Publication No. 4626)

George Clarkson Bliss, Ed. D.
Stanford University, 1953

This study presents an analysis of the 1951-52 salary schedules of the twelve cities in California with populations over 90,000 for the purpose of determining the issues and conflicts engendered in the administration of these salary schedules. Answers were sought to the questions: What are the similarities and differences in the administration of the salary schedules in the selected cities? What issues and conflicts of salary scheduling are raised by the administration of the salary schedules in the selected cities?

The data for the study were derived from the salary schedules from the twelve cities plus a structured conference with the person in charge of the administration of the salary schedule in each city.

The study of the schedules revealed wide variations in every aspect of salary schedule administration. Every factor of salary schedule administration is an issue in itself, if variation in practice is the criterion.

There is but one common principle underlying teacher salary schedule construction as revealed by the analysis of the twelve city schedules. It is that a single salary schedule should be used. By single salary schedule is meant equal pay for equal training and experience irrespective of sex and school grade level taught. This schedule is based upon two elements — training and experience — as the two coordinates with no agreement whatever beyond that as to other constants. Moreover, in all schedules studied, quantitative measures of teaching competence were used rather than qualitative ones. This raises the question: Can you judge qualitative matters in quantitative terms? Every school salary schedule apparently is content to believe that one can.

As a result of an analysis of all factors the following issues were raised:

I. What should be the scope and format of a salary schedule?

II. What number and type of classifications should be included in a salary schedule to encourage teachers for professional growth?

III. What should be the relationship between minimum and maximum salaries?

IV. What should be the number of years required of a teacher to reach maximum?

V. What should be the size of increments between steps and classifications?

VI. What should be the placement of new appointees to the system?

VII. What factors should condition salaries other than qualifications, experience, and assignment?

VIII. What should be the basis upon which teacher load is adjusted?

IX. What methods should be used to carry out the schedule?

X. What practices in schedules should apply to professional staff members who are not classroom teachers or are teachers in highly specialized fields?

XI. What means should be used to reward competence in teaching?

XII. What limitations should be placed on teachers in reclassifying them in a higher salary classification?

XIII. What experiences should be recognized as improving teacher effectiveness?

XIV. What should be the relationship of administrative and supervisory salaries to salaries of classroom teachers?

XV. Should the school system put more emphasis on their own courses and workshops rather than on institutional training?

The issues listed above grew out of conflicts in practice. They arise out of disagreements about salary schedule construction procedures and seem to result from bargaining and compromising rather than from differences in basic principles.

In addition to the fifteen issues listed above there were other fundamental problems of salary schedule construction on which there was no agreement. These were:

I. Should the schedule include basic statements of the aims sought and the principles being followed?

II. How shall the factor of salary classification be carried out?

III. Who should formulate and administer the salary schedule?

IV. What experiences are valuable to improve classroom teaching effectiveness?

V. Is it possible to judge qualitative changes in quantitative terms?

The study provides conclusions and points up issues that may serve as guideposts for those charged with the responsibility of formulating and administering salary schedules. Probably what is needed is not further search for basic principles of salary schedule making so much as better definition and agreement upon elements of schedule construction more surely to develop better teachers.

Microfilm copy of complete manuscript of 378 pages, $4.73. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-380.

A PROPOSED UNIFORM FINANCIAL ACCOUNTING SYSTEM FOR THE ARKANSAS PUBLIC SCHOOLS

(Publication No. 4906)

James William Cady, Ed.D.
University of Arkansas, 1953

Unsatisfactory conditions in school financial accounting are common in Arkansas. This study was undertaken in order to develop a financial accounting system that could be adopted as a satisfactory system for the school districts of the state. The problem of this study was the development of such a financial accounting system with due consideration to the many factors which affect such a system.

Following a survey of the literature of school financial accounting, a proposed list of criteria for a uniform financial accounting system for Arkansas was developed and copies were sent to individuals in each of two groups. The first group consisted of ten men actively engaged in school financial accounting in the state. The second group consisted of ten Certified Public Accountants who have had experience in auditing the accounts of Arkansas school districts. The twelve criteria were validated through the rankings of these twenty men and the fact that they neither added or deleted any criteria as they were invited to do as they thought necessary.

The twelve criteria, in abbreviated form, are as follows: (1) conformity with state law, (2) uniform system of accounting, (3) desirability of expansion and contraction, (4) allowance for diversity, (5) accessible accounting information, (6) minimum bookkeeping knowledge, (7) protection against loss and misuse of money, (8) minimum amount of time keeping records, (9) control of receipts, (10) facilitate annual school district report, (11) accounting for assets and liabilities, (12) manual of accounting instructions.

Using the developed criteria as a basis, the present accounting system of the schools of Arkansas was analyzed and its limitations noted. The current system of accounting in the state met only two of the criteria satisfactorily. After the analysis of the present system of Arkansas school accounting, a new accounting system was developed which conforms to the accepted criteria for evaluation, and, in this respect, is suitable for use in the school districts of Arkansas. The first thirteen forms of this proposed accounting system are for the purpose of accounting control of the monies and supplies accruing to the school districts. The next nine forms are information forms. They do not control receipts and expenditures, but are for the purpose of furnishing certain necessary information which is required in the efficient management of school districts in Arkansas.

A major recommendation of this study is that the State Board of Education adopt the proposed financial accounting system as the official one for use in the school districts of the state. A second recommendation is that school districts now using machine bookkeeping be exempted from compulsory adoption

of the new system. A third recommendation is that the future adoption of machine accounting systems in school districts that do not now use machine systems shall be made to conform to the proposed accounting system. A fourth recommendation of this study is that the annual report of the county supervisor to the state, and the annual report of the school district to the county should each be revised and made to conform, insofar as possible, exactly to the state adopted accounting system.

Suggestions for further study include studies to determine the possibility of setting up: (1) a uniform system of pupil accounting and cumulative record forms, (2) county-wide accounting systems, and (3) a system of quantity purchasing of supplies and/or equipment on a county or district basis.

Microfilm copy of complete manuscript of 321 pages, $4.01. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-381.

AN ANALYSIS OF CERTAIN METHODS AND PROCEDURES USED BY LOCAL BOARDS OF EDUCATION IN ARKANSAS

(Publication No. 4907)

Norval Denver Hazelbaker, Ed.D.
University of Arkansas, 1953

Purpose of the Study

The purpose of this study is to ascertain and analyze certain of the methods and procedures used by local boards of education in the state of Arkansas in the discharging of their responsibilities for the control and direction of public education within their respective areas, and to analyze and compare these practices with recommended procedures by authorities in the field of educational administration.

Method of Research

Analysis of data obtained from information blanks sent to executive officers of local boards of education in the state of Arkansas and to professors of educational administration in institutions of higher learning in the United States concerning certain methods and procedures used by local boards of education.

Summary

Agreement was found and reported on the practices used by local boards of education in Arkansas and the opinions of professors of educational administration concerning certain methods and procedures studied that fall in the following areas:

1. Holding closed school board meetings occasionally.
2. Holding special meetings or meetings other than those regularly scheduled.
3. Following an order of business in conducting school board meetings.
4. Having current publications dealing with the practices of school administration available for board members.
5. Attending some professional meetings during the school year.
6. Making school board minutes accessible to the public.
7. Delegating certain administrative functions to the superintendent of schools.
8. Performing certain administrative functions jointly with the superintendent of schools.
9. Promoting school-community relations through the use of certain methods and procedures.
10. Performing the appraisal function on the basis of information secured from certain sources.

Little or no agreement was found between the practices used by local boards of education in Arkansas and the opinions of professors of educational administration concerning certain methods and procedures studied that fall in the following areas:

1. Regular meeting place for the local board of education.
2. Methods used to notify board members of meeting dates.
3. Holding dinners or luncheons in conjunction with regular school board meetings.
4. Preparing and presenting an agendum to board members in advance of meeting dates.
5. Accessibility of books dealing with the school board member and his duties.
6. Use of special school board committees.
7. Responsibility for keeping school board minutes.
8. Use of written rules and regulations of the board of education.
9. Division of responsibility for the performance of certain administrative functions.
10. Use of certain methods and procedures in promoting school-community relations.
11. Use of certain practices in evaluating the educational program of the school.

Conclusions and Recommendations

Local boards of education in the state of Arkansas should give serious consideration to the following practices which are considered to be desirable.

1. Holding all school board meetings in the school building where reports and records are on file and available for reference.
2. Keeping the number of closed school board meetings held at an absolute minimum.
3. Holding more frequent informal social activities in conjunction with regular school board meetings.
4. Preparing an agendum or schedule of topics for discussion at board meetings and making it available to members in advance of meeting dates.
5. Giving more consideration to the methods used to encourage patrons to attend open school board meetings.
6. Making more materials available to newly elected school board members to assist them in becoming acquainted with their work.
7. Attending professional meetings considered to be of value to school board members.

8. Preparing a written set of rules and regulations for the board of education.
9. Encouraging participation of lay committees in cooperative planning for the educational program of the community.
10. Using a greater variety of methods to evaluate the educational program of the school.
11. Preparing a written statement of the division of responsibility between the superintendent of schools and the board of education.
12. Employing the secretary to the superintendent to serve also as secretary to the board of education and be responsible for keeping the official records of the board.

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A STUDY OF SOME FACTORS ASSOCIATED WITH THE WITHDRAWAL OF STUDENTS FROM THE SECONDARY SCHOOLS OF ARKANSAS

(Publication No. 4908)

Jesse Dee Henry, Ed.D.
University of Arkansas, 1953

The Problem

With the great expenditures which are made for secondary education and with the need for a secondary education becoming more necessary for the individual and for society, every effort should be made to keep youth from withdrawing from secondary school before they are graduated.

In order to improve the holding power of schools, it is necessary to determine the factors which are associated with pupils' decisions to withdraw from school.

This study was made in an attempt to find the factors associated with withdrawals from the secondary schools of Arkansas.

Conclusions from Related Studies

A survey of previous studies provides the following generalizations:

1. No single set of factors affecting withdrawals in one geographic area will apply to another.
2. The major factors associated with withdrawals are marriage, work, lack of interest, and lack of ability.

The Sources and Analysis of the Data

Representative sample schools were selected and studied individually in an attempt to locate both general and specific factors associated with withdrawals. Sample schools included rural and urban, white and colored, various types of organization, large and small, and were distributed over the state.

In each sample school visited, the records of the ninth grade class of 1946-47 were traced to graduation in 1949-50 in order that each withdrawee might be identified and studied.

The grade 9 enrollment in 1946-47 in these schools was 1,213 and 757 of this number were graduated in 1949-50, leaving 456 who were not graduated. Of these 456 students, 150 could not be located for study, and the remaining 306 withdrawees constituted the subjects of this study.

School officials, teachers, withdrawees, and parents of withdrawees were interviewed in order to determine all possible factors associated with withdrawing.

Findings and Conclusions

The findings and conclusions of the study fall into three areas as follows:

1. General factors associated with withdrawals in Arkansas.
   (a) Schools with a higher classification or rating retain a higher per cent of students to graduation.
   (b) The 8-4 type of schools retained a higher per cent of those who enrolled until graduation.
   (c) The per cent of withdrawals was found to decrease as the number of curricular and co-curricular offerings increased.
   (d) As the number of non-elective courses increases, the per cent of withdrawals increases.
   (e) As the number of vocational course units offered increases, the per cent of withdrawals decreases.
2. Specific factors associated with withdrawals in Arkansas.
   (a) Twenty specific factors were found to be associated with withdrawals in Arkansas.
   (b) Of the twenty specific factors associated with withdrawals in Arkansas, six were found to be predominant. It was found that marriage affected 24.8 per cent, lack of interest 15.4 per cent, lack of ability 9.8 per cent, overageness 9.2 per cent, and work 8.5 per cent of all withdrawals studied.
3. Symptoms of withdrawal were found to be:
   (a) Overageness.
   (b) Drop in regularity of attendance.
   (c) Drop in school marks.

Recommendations

The following recommendations are included in the study for improving the holding power:

1. General improvement in the quality of the total school program is needed.
2. The curriculum, including the vocational course offerings, should be expanded to more adequately meet the needs and interests of students.
3. The co-curricular program should be expanded to provide for special interests of students.
4. Non-electives should be decreased.
5. Better health records should be kept in an effort to foster better health among students.
6. Retardation and suspension should be carefully considered before action regarding either is taken.

7. School personnel should take steps to make school life more interesting and valuable for all students.
8. Every reasonable effort should be made to locate potential withdrawees early and to take all possible action to prevent withdrawals.
9. Students should be assisted in obtaining part-time work.

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A STUDY OF PUPIL PARTICIPATION COSTS IN THE PUBLIC SECONDARY SCHOOLS OF ARKANSAS

(Publication No. 4909)

Wanda Hollingsworth Walker, Ed.D.
University of Arkansas, 1953

Introduction

The social organization prevalent in the United States is based upon the idea that all human beings have equivalent moral value. Since Americans have accepted this idea as the foundation of democracy, educational opportunities should be equally available to all youth; however, there is evidence that the high schools are not cost-free institutions. Although there are no direct tuition fees, there are special fees and incidental expenses which students must pay if they attend and participate in various activities, a factor which has prevented many from enrolling and causing others to withdraw before graduating.

Administrators should become aware of the kinds of items for which pupils are assessed or expected to expend money and the amounts expended for them.

The Problem

The purpose of this study was to determine the extent and magnitude of pupil participation costs in the public secondary schools of Arkansas, exclusive of the costs of food, shelter, ordinary clothing, and transportation. The study was confined to the school year 1951-52 and included both white and colored schools. Secondary education was defined as grades nine through twelve.

Methods and Procedures Employed

A questionnaire designed to determine costs was prepared, which was divided into three categories with a separate inventory for each type of expenditure: (1) for academic subjects; (2) for participation in cocurricular activities, and (3) for attendance at school functions, such as graduation.

Questionnaires were received from one hundred thirty-six schools representing 22,671 pupils. The schools were located in sixty-five of the counties and represented twenty-four per cent of the secondary schools of the state.

Summary of Findings

A study of the findings made through the use of these inventories revealed the following facts:

The money spent for textbooks, fees, deposits, and assessments constituted a major part of the total cost in connection with certain subjects. Commercial and vocational subjects were more expensive for students than college-preparatory courses. Costs varied more from school to school than among subjects within the same school.

Costs for participating in cocurricular activities included the purchase of special clothing and equipment required in athletics, dramatics, music, and clubs. Other costs included membership dues, fees, pins, materials, parties, trips, and purchase of school publications. Only twenty-three schools reported no costs in connection with activities. Membership in service and honorary clubs cost less than subject-extension activities.

General participation costs included attendance at school-sponsored functions, class dues, movies, social functions, personal materials, and graduation expenditures.

Costs generally increased from the ninth grade through the twelfth grade.

There was no consistent pattern of higher costs for boys or girls.

Total costs ranged from $68.15 for the ninth grade college preparatory curriculum to $129.91 for the commercial curriculum. The median cost per year for taking subjects, participating in an average number of sports and other activities, and attending school-sponsored functions was about $84.00 in the college preparatory curriculum. In the commercial curriculum the median cost was over $90.00.

For the same year, the annual per-pupil expenditures for students enrolled in the secondary schools of Arkansas were about $109.00. In order to offer free of cost to pupils most of the programs recommended in this study, it would be necessary to spend almost twice as much per pupil each year as is now being expended.

Recommendations

The public high schools of the state should be made equally available to all children eligible to attend. The cost of attending should be held to a minimum or eliminated entirely. Revenue for the schools should be increased until all desirable programs can be financed through an adequate program of taxation and offered free of cost to all students.

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EDUCATION, HISTORY

THE STRUGGLE FOR ACADEMIC FREEDOM IN JAPANESE UNIVERSITIES BEFORE 1945

(Publication No. 4901)

Doo Soo Suh, Ph.D.
Columbia University, 1953

The attempt to verify truths as truths at any payable cost has been supreme among university constituents — both teachers and students — even in the empire of Japan, which has been known to the world as a characteristically totalitarian country. Certainly many teachers and students have sacrificed their all on the altar of university freedom.

The administrative authorities of Japan, organized as a highly entrenched bureaucracy, convinced themselves that they were loyal to their country. They endeavored to keep the state as a country of the gods, reigned over by the lineal descendants of the Sun-Goddess living on the High-Heaven Plains. This state "myth" eventually led to severe restrictions on academic freedom in Japanese universities, — a story which forms the subject matter of the present study.

The early skeptical frame of mind of university teachers and students in Japan flickered from time to time during the Meiji and Taisho eras after the country made its university system modern according to the Western pattern. Later in the Showa era there was a progressive deterioration of the skeptical spirit up to the end of the Pacific War in 1945, when there took place the unconditional surrender of the country. The efforts of the government to make the university its mouthpiece — never anything more — was severely fought by the constituents of the nation's highest seats of learning. The defining of university aims by the government in ordinances and regulations designed to meet the needs of the state caused many conflicts over academic freedom in Japanese universities.

Backed by the traditional concept of emperor-worship, the government tried hard to keep some constancy in the interpretation of the articles of various ordinances and regulations on university education. The interpretation of Article I of the well-known Ordinance on the University of 1918 became the cause of many collisions between the surveillance of the government and the enthusiasm of university men. The faculty believed that universities existed for the purpose of pursuing truth as well as for teaching and publicizing the results of truths found by research according to their own academic consciences. Article I reads:

> The aim of the university is to teach principles and their applications to students so that they may fulfill the needs of the state, and at the same time to engage in research regarding those principles. Furthermore, attention shall be paid to developing the student's personality and to nourishing state thoughts.

The interpretations and applications of the fourth clause of Article II of the Civil Service Ordinance of 1899 were used as a bulwark of the government, as well as a target for the attack of university men for many decades, because it regulated the suspension of university professors "at the convenience of the government agent".

The battle for academic freedom was temporarily lost in Japan because an over-emphasized and ingransigent nationalism in the 30's and 40's was used for the convenience of the government to render universities its handmaidens in the name of the emperor's country.

Self-government in the university was advocated from early Meiji times by the faculties. The rights of university heads in personnel administration with regard to professorial members was also consistently championed. The antagonism between the government and the universities focussed on many issues in the line of university administration.

Eventually, however, both sides failed to realize the full meaning of education in university administration. Japanese universities gradually extinguished the spark of academic freedom that had flickered from the early days. The fitful course of the fight for some degree of academic independence in Japanese universities has been investigated historically in the present study which is entitled, The Struggle for Academic Freedom in Japanese Universities before 1945.

Microfilm copy of complete manuscript of 493 pages, $6.16. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-385.

EDUCATION, PHYSICAL

SPACE AND FACILITIES FOR PHYSICAL EDUCATION AND COMMUNITY USE IN PUBLIC SCHOOLS

(Publication No. 4651)

Allan Ray Elliott, Ed.D.
Stanford University, 1953

The major purpose of this research was to develop guiding principles or standards for determining the amount of space and the facilities needed for physical education in public schools. To accomplish this objective it was necessary to develop a philosophy of physical education and to establish the need for instruction in physical education activities in the elementary school grades.

The starting point for planning school buildings and for developing elementary school sites must be the program of education to be carried on within those facilities. Since this is an accepted principle, it is highly desirable to develop an acceptable program of physical education for each elementary school grade. From these programs of activities should be derived the space needs for physical education in the elementary school.

A search of the literature reveals that educators for a great many years have been urging the purchase of larger sites for elementary school playgrounds. These data do not indicate that anyone has ever determined exactly how much space is needed for these playgrounds. Standards for school sites and playgrounds have appeared over the years, none of which adequately meets the needs of the educational program.

Conclusions based on the findings in this research were:

1. A philosophy of education which considers the total growth and development of each child is needed to plan the school program and to develop the physical features of the school buildings and the school site.

2. An educational program must include instruction in physical education activities for each grade in order to achieve the goal of optimum development of each child.

3. Except for buildings, walks, drives, service areas, and landscaping, elementary school planners have given little attention to the development of the site based on the educational program.

4. Existing standards for elementary school site sizes are not based on actual educational program needs.

5. Standards for elementary school site sizes based on flat acreage, square feet per pupil, or a formula indicating acreage for ultimate capacity enrollment of the school do not provide accurate standards derived from actual program needs.

6. The only acceptable standard for determining the elementary school site size is one based on needs determined by the program of instruction in physical education for each grade that is to be housed in the school.

7. Space needs for physical education become greater as the grades progress upward from the kindergarten to the eighth grade; i.e., the physical education program for third grade children requires more space than the physical education program for kindergarten, first, and second grade children; the program for the sixth grade boys and girls requires more space than is required for children in the fourth, and fifth grades; and the program for boys and girls in the junior high school grades requires considerably more space than for any of the other elementary school grades.

8. In order to provide children with opportunities for experiences which will contribute to the optimum growth and development of each child, an outdoor physical education area should be provided with a hard surface area, a turfed area, and an apparatus area containing those pieces of apparatus that can be justified educationally.

Tables of standards are presented for each grade and for each of a variety of types of graded elementary schools found in existence during this study. These standards show considerable variation in recommended site sizes based on the particular grades that might be included in the school. Sites from three and one-half acres to over thirteen acres are shown permitting a range from 150.1 to 1818.8 square feet per child for physical education space.

Microfilm copy of complete manuscript of 356 pages, $4.45. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-386.

EDUCATION, PSYCHOLOGY

THE RELATIONSHIP BETWEEN PERSONALITY CHARACTERISTICS AND EFFICIENCY IN THE USE OF AURAL SENSORY AIDS BY A GROUP OF ACOUSTICALLY HANDICAPPED PATIENTS

(Publication No. 4621)

Victor B. Elkin, Ph.D.
New York University, 1952

This is a study of the performance of two groups of patients 22 Efficient hearing aid users and 22 Inefficient hearing aid users, on the Rorschach, Level of Aspiration Test and Biographical History Inventory. The problem is to determine whether these two groups of hard of hearing patients can be differentiated on the basis of personality characteristics. The hypothesis being examined is; holding anatomical, physiological, medical and mechanical conditions relatively constant, the ability to utilize a hearing aid efficiently is largely dependent upon the nature of the individual's personality structure.

The subjects are all male, white, hard-of-hearing veterans of World War II between the ages of 20 and 50 years, who have a bilateral organic auditory impairment of 30 to 70 decibles. All subjects had been issued hearing aids for at least three months and not more than four years prior to the beginning of this research. Patients who were suspected of having a psychogenic hearing loss, in addition to, or in place of, their organic hearing loss were excluded. The hearing aids were issued at the Veterans Administration, New York Regional Office, Auditory Rehabilitation Clinic.

The groups were equated with respect to age, education, amount of hearing loss and intelligence. The means for chronological ages are: Efficient group 33.50; Inefficient group 32.27. The means for the school grades completed are: Efficient group 11.18; Inefficient group 11.55. The mean intelligence quotients are: Efficient group 102.45, Inefficient group 103.91. The differences between the means on each of these factors are statistically unreliable. The mean hearing loss in decibles for each group is: Efficient group 45.68; Inefficient group 45.72.

In this study significant differences appear between the groups in their performance on the Rorschach, Level of Aspiration and Biographical History Inventory Tests. No contradictory findings appear and the results of these tests frequently augment and complement each other.

The Efficient group were better students, more socially active at school, had a greater number of close male friends and entered into marriage more frequently than did the Inefficient group. In addition, the Efficient group changed their jobs less frequently following loss of hearing, spent more time at their major job and had improved relationships with friends and family after securing a hearing aid than did the Inefficient group.

The Inefficient group were judged to be isolated and depressed as compared to the Efficient group, who were judged to be gregarious and relatively free of depression. With respect to the ability to relate to people, the Efficient group were judged to have greater capacities in that direction. The Inefficient group manifest marked degree of anxiety as contrasted to the Efficient group who were relatively free of anxiety.

The Level of Aspiration test reveals that the Inefficient group have in their personality structure the need to aspire to goals on an unrealistic basis. They either unrealistically over-estimate their competency and strive toward goals which are insurmountable or they under-estimate their capacities and establish unrealistically low levels of aspiration, thereby insuring success. The Efficient group appears to judge their capabilities realistically and maintain levels of aspiration within their scope of accomplishment.

It must be realized, however, that the results obtained in this research which reveal significant differences between the groups, may hold true only for the specific population of this study. They should not be applied to other individuals or groups indiscriminately without extensive further research.

Microfilm copy of complete manuscript of 167 pages, $2.09. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-387.

REALITY PRACTICE AS A PROCEDURE IN COUNSELOR TRAINING

(Publication No. 4669)

Norman James Harris, Ph.D.
Stanford University, 1953

Counselor trainers have long felt the need for training procedures to bridge the gap between the academic preparation of counselors and their assignment to practicum facilities. Reality practice (or role playing) has been suggested and used in various counselor training situations as a device which serves this purpose. It has been assumed that reality practice is sufficiently like the real counseling situation to warrant its use in training. The study was, in part, a comparison of reality practice counseling with the real counseling situation in an attempt to illuminate the assumption that the two situations are not different.

Reality practice has been used as a test of counseling behavior; the assumption being made that a counselor trainee's behavior in the reality practice interview predicts his behavior in the real interview. The study investigated the relationship between reality practice interviews and real counseling interviews.

The method used in these comparisons was the analysis of tape recorded interviews of thirty-nine counselor trainees. Each trainee recorded an interview with a graduate student who played the role of a high school student, and an interview with a real high school student. Analysis of the recorded material was made in terms of a continuum of leading. Three independent judges analyzed the sound recordings in order to assess the experimenter's reliability in rating. It was concluded that the experimenter could rate the interview with an acceptable degree of reliability.

A verbal stimulus test was developed consisting of client remarks recorded on tape. The subjects were asked to respond as the counselor to this recorded material by writing their remarks. Analysis of this test was made on the continuum of leading used in the analysis of the interview materials.

The difference between the means of the reality practice interviews and the real interviews was not statistically significant. Confidence limits of the difference between the means were given and evaluated. A high positive statistically significant correlation between the main variables, reality practice counseling, and real counseling was found. A low positive statistically non-significant relationship was found between the Verbal Stimulus Test and the main variables.

Qualitative analysis of the data gave rise to suggestions for the use of the procedures developed in the study with groups and individuals in counselor training.

It was concluded that reality practice counseling and real counseling are not proven to be different situations in so far as the degree of leading used by the counselor is concerned. Reality practice as a measure of counseling behavior in terms of the degree of leading shown by the counselor trainee was suggested as having considerable value. Use of the Verbal Stimulus Test did not seem warranted as a measure of counseling behavior when the degree of leading was used in the analysis.

Further research using reality practice as a measure of change was suggested.

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EDUCATION, TEACHER TRAINING

EVALUATION OF HELPING TEACHER'S CONTRIBUTION OF INSERVICE EDUCATION OF TEACHERS IN RURAL SCHOOLS OF MICHIGAN

(Publication No. 4707)

Verne Allen Stockman, Ed.D.
Michigan State College, 1952

The inservice education of teachers for the improvement of instruction presents a problem to rural America. The purpose of this study was to survey the services supplied by the helping teachers in Michigan and to evaluate these services as seen by the teachers served, the helping teachers, and the County Superintendents. The role of the helping teacher was analyzed in an attempt to find out - (1) What teachers, helping teachers, and County Superintendents consider is their role, (2) what kinds of processes and skills enable the helping teacher to help teachers improve instruction, and (3) what differences are evidenced between a county with a helping teacher and a county without a helping teacher?

A questionnaire was used to secure the opinions of (1) teachers who worked in counties with helping teachers, (2) teachers who worked in counties without helping teachers, (3) helping teachers, and (4) County Superintendents.

The questionnaire was divided into five areas. These were: The role of the helping teacher in (1) the improvement of teaching methods and techniques, (2) developing democratic living in the school, (3) recognizing and using individual differences, (4) developing community and school relations, and (5) administering the school.

In general teachers were more interested in help in specific teaching techniques and less concerned with help in the way children learn, their social and emotional adjustment, the use of community resources, and interpreting the child and the school to the home and the community.

The helping teachers felt keenly the needs of teachers to know the child, to recognize and use individual differences found, and to make the community aware of the job the school should do. Their greatest interest was shown in the area of democratic living. They were particularly anxious to get teacher-participation in planning meetings and programs.

The County Superintendents rated the same items somewhat lower but, in general, agreed with the helping teachers.

Case studies were made of two counties that had a similar rural level of living index. These counties selected were County A with a helping teacher for six years and County B which had no helping teacher service.

In County A, the helping teacher filled out a daily report for the County Superintendent. Forty-five percent of the reports made some evaluation of the teacher's competence, skills, and abilities. Other types of activities carried on by the helping teacher were ranked in the following order: (1) working with parents and community groups, (2) problems of teachers, (3) working with teacher-planning-groups, (4) helping teachers with room arrangement, and (5) the preparation of the news letter. There were many other activities that varied from year to year.

In County B, the County Superintendent tried to do something about improving the instructional program, but he felt he could not begin to meet the needs.

In general, County A with helping teacher service, made many more contacts with teachers, provided a much wider program of services, and carried on a much more concerted and better organized program of activities than the County B superintendent, without a helping teacher, was able to provide.

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EDUCATION, THEORY AND PRACTICE

SOME IMPLICATIONS OF EXPERIMENTALISM FOR TEACHING PUBLIC SPEAKING

(Publication No. 4703)

Hugo John David, Ed.D.
Michigan State College, 1952

The conversational mode of speaking and the educational philosophy of experimentalism developed, for practical purposes, almost simultaneously. The purpose of this study, therefore, has been to determine in what ways and to what extent this philosophy has influenced the writers of textbooks for college courses in public speaking. Accordingly, three major divisions result: an explanation of the principles of experimentalism, its application to teaching public speaking, and an examination of six selected textbooks currently in extensive use in college and university public speaking classes.

Experimentalism, expounded by John Dewey primarily, is founded on man's experience in interacting with his physical and social environment. Intelligent interaction necessitates inquiry from which results learning. Knowledge, intelligence, and thinking are described in relation to this method. The instructor's task is to provide learning experiences which originate in the student's living and constitute problems whose solution requires the intervention of intelligence. In practice speeches students experiment with speech methods and devices and have opportunity for intelligent practice of skills.

Fundamentals of Public Speaking by Bryant and Wallace reveals no important influence of experimentalism. The pattern of inquiry receives scant mention. The method of learning is preceptive and teaching is authoritative. Students learn principles and apply them in practice speeches. Evaluation of student effort is based on conformity in practice to principles learned.

Crocker's Public Speaking for College Students, founded on classical rhetoric, advises conformity to principles and extensive practice of them. Evaluation of student's work is based on application of prescribed standards, not on the effect of classroom experiences on student growth.

Sarett and Foster in the revised Basic Principles of Speech believe man is malleable by experience but they prescribe his experience for him. Students should emulate noble examples in thought, language, and style.

In Basic Training in Speech: Brief Edition Thonssen and Gilkinson seem to accept an experimentalist view of experience and emphasize the pattern of inquiry. Their learning theory, however, reinterprets "experience" as following regulative principles and gives great significance to the stimulus-response mechanism. They accept as fundamental certain ideas basic to experimentalism but disregard weighty implications.

The third edition of Monroe's Principles and Types of Speech advocates the pattern of inquiry as a method of organization for all types of speeches, but learning is following principles and directions. The author professes eclecticism despite recognizable inconsistencies. Accordingly, an audience can learn via the method of inquiry while the student must learn speech-making by accepting and applying prepared principles.

Baird and Knower conform extensively to experimental principles in General Speech: An Introduction. The pattern of inquiry is the method of learning and speaking experiences are seen to affect student knowledge, attitudes, and skills. The concepts of knowledge and ultimate truth seem non-experimentalist. Of the texts examined, this one leans most heavily upon the theory of experimentalism.

While textbook authors are under no compulsion to subscribe to experimental principles, they might, however, give additional thought to the consistency with which they adhere to some point of view, even if eclectic.

Microfilm copy of complete manuscript of 326 pages, $4.08. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-390.

NUMBER GROUPING AS A FUNCTION OF COMPLEXITY

(Publication No. 4650)

Daniel Turnure Dawson, Ed.D.
Stanford University, 1953

The purpose of this investigation was to study the conditions under which children apprehend numbers as groups. Several previous studies of number grouping have been reported. The purpose of the earlier studies was to determine what number groups children know. Later studies were concerned with context, form, and pattern as they affect the apprehension of number. Studies were also made of the effect of size and color on perception.

Relationships between speed of response and the method of response, and the speed of response and the nature of the representations have not been reported in the literature; nor has a study in which the arrangement of the perceptual field has been kept constant and the nature of the representations varied been reported. It is one of the purposes of the present study to supplement available knowledge in these areas.

A theory proposed by DeMay, and widely accepted in the literature and practice, states that children begin with "concrete objects", progress to experiences with pictures of objects, then to "semi-concrete" materials and end with the use of number symbols. No evidence exists that this hierarchy of representations has been empirically validated. Despite the apparent lack of any attempts to validate this proposal and in the fact of some evidence in contradiction to it, many of the leading writers in the field of elementary arithmetic have based procedural recommendations upon this hypothesis.

Further study of the problem led this writer to propose the hypothesis that number grouping ability is a function of the complexity of the perceptual field rather than a function of the DeMay continuum.

Specifically, greatest recognition of entities (number groupness) will be achieved through symmetry, simplicity, and homogeneity of elements. Conversely, complexity is created by a lack of total symmetry, many component elements, heterogeneity of group elements, and poor figure-ground relationships.

In order to test the complexity hypothesis, a procedure was employed utilizing a set of sixteen cards, four each for the number groups 4, 5, 6, and 7. Each number group was pictured at four "levels of complexity" from Type I (least complex) through Type IV (most complex). The cards were presented in a mixed but constant order.

The test was administered to first, second and fifth graders in schools in three varying socio-economic areas. Responses from 76 first graders, 28 second graders, and 24 fifth graders were useable. Appropriate measures were taken to control the testing procedure, prevent anxieties and the like. Each test was administered individually and complete data on time, nature of the response and any observations were recorded.

The method of Chi-square (X^2) was used to determine the statistical significance of the findings because normality of distribution could not be assumed. The coefficient of mean square contingency was used as a measure of relationship.

The findings of this study support the complexity hypothesis for each number group tested at the first grade, and for the number 4 and 5 groups at the second grade. Findings were significant at the $P = .05$ level or better. Results for the fifth grade were inconclusive. For primary children, results indicated that the progressive complexity of the cards I-IV would make them more difficult to perceive. The critical factor was apparently, not that they were "geometric" or "pictorial", but that they were progressively more complex.

Two other factors related to the findings were

noted. First, if level of response is taken to mean counting (level A), sub-grouping (level C), or grouping (level D), then at the first grade there was a significant relationship between the speed of response and the level of response (P = .05 or better) for each of the sixteen cards. Further study needs to be made of the relationship between speed of response and level of response. Second, if the responses of children become progressively more mature, as indicated by the level of response, then a developmental pattern exists. First graders usually count, second graders usually subgroup, and fifth graders group the number group pattern presented.

The findings of this study offer what appears to be a more heuristic construct to replace the DeMay hypothesis. In view of the critical nature of grouping ability in arithmetic, such a reorientation merits further investigation at similar and more advanced age-grade levels.

Microfilm copy of complete manuscript of 103 pages, $1.29. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-391.

ENGINEERING

ENGINEERING, GENERAL

THE EFFECTS OF KNEE BRACES ON THE ECONOMY OF RIGID STEEL FRAMES

(Publication No. 4839)

Li Tang Au, Ph.D.
University of Minnesota, 1952

The investigation is divided in three parts. The first part deals with the theoretical analysis of knee-braced structures. The second part is an account of tests carried on models and specimens. The last part is a comparison of theoretical and test results and lists conclusions to be drawn from these.

In the theoretical part, different methods of analysis such as methods of least work, slope deflection, moment distribution, successive correction and modified relaxation are mentioned and different kinds of rigid frames are used as examples.

An approximate solution for braced rigid frames is worked out with precise moment distribution and an abstract of the method used to determine the stresses in the knee of a rigid frame by the theory of elasticity is presented.

Two models and thirteen specimens were used for the test. Electrical resistance strain gages were used in two gable frames (height 2'6", span 5'0" and section 1-1/2"x2-3/8" I) and four big L-frames (two 1'10-1/2"x1'10-1/2" 417.7 and two 2'x2' 4M13). Huggenburger strain gages were used in nine small L-frames (1'x1'x1/8").

The external loads for the two gable frames were furnished by tightening the nuts of two vertical rods which in turn pull the top joint of the frame down. Finally, these two frames were tested under a 400,000 lbs. universal testing machine to provide a check.

All the L-frames were tested in a 120,000 lbs. direct-acting hydraulic testing machine. The big four L-frames were tested under compression and the nine small L-frames were tested under tension.

The observed stresses in the models and specimens are shown in the thesis and indicate the difference in stress conditions in the two types of rigid frames, those with knee braces and those without.

Tables are included to compare the stresses at the critical points of two gable frames obtained from theory with the stresses determined from the observed strains.

The comparisons among the ultimate strength of four groups of L-frames confirm the theoretical deduction that knee braces can be used to stiffen a rigid frame. One group of the specimens shows the effect of varying the length and position of knee braces on the strength of a rigid frame. Another group of the specimens brings out the effect of varying the width of one leg. They show that the frame with larger width has greater strength.

The conclusions are that knee braces can be used in a rigid frame to eliminate the high local stress found at the sharp corners of the frames; to reduce the bending moment on the columns due to horizontal loads and to transfer the large moments from weak points such as a joint to some less critical place.

By the use of the knee braces, a saving of material and a reduction of dead load in a rigid frame may be effected.

Knee braces can be used to advantage in bridge frames, crane bents, industrial building frames and for wind connections in tall buildings.

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ENGINEERING, CHEMICAL

THE VAPOR-LIQUID EQUILIBRIUM OF THE SYSTEM METHANOL-ETHANOL-ACETONE AND ITS COMPONENT BINARIES

(Publication No. 4654)

Hamed Hassanein Amer, Ph.D.
Stanford University, 1953

A complete set of atmospheric vapor-liquid equilibrium determinations for the ternary system methanol-ethanol-acetone and its component binary system is presented. The equilibrium relationships on the three binary systems methanol-ethanol, acetone-ethanol, and acetone-methanol are individually compared with the corresponding vapor-liquid equilibrium data reported by other investigators.

A modified Colburn equilibrium still was used for the determination of the vapor-liquid equilibrium relationships of all systems. The pressure inside the still was maintained constant at 760 mm. Hg.

Analyses of the vapor and liquid samples obtained were done by measurement of their specific gravities, refractive indices and bubble points. Diagrams of refractive-index vs. composition were constructed and used to determine the composition of the liquid and the condensed vapor samples for the methanol-ethanol and the acetone-methanol systems. A bubble point-composition diagram was employed for the same purpose in the case of the acetone-ethanol system. For the determination of sample compositions in the case of the ternary system, two triangular plots were prepared, one showing lines of constant bubble-points and the other showing lines of constant refractive indices. The composition of the liquid and condensed vapor samples was read from a single analytical plot formed by superimposing the two triangular plots previously mentioned on each other.

Thermodynamic consistency of the binary system data was checked by means of the Margules three-suffix equation. The two constants employed in the equation were determined by extrapolation of the experimental activity coefficient-composition plots to zero concentrations and by Gilliland's straight line method. This latter method involves plotting functions of the activity coefficient and composition against different functions of the composition and then drawing the best straight line through the data. The slope and intercept of such a line determine the two constants. In employing the straight line method, the experimental data together with the literature data on each binary system were used to evaluate the two constants. Thermodynamically consistent vapor-liquid equilibrium curves for the three binary systems were then calculated and compared with the experimental data. The two methods employed in determining the binary constants gave comparable results.

Thermodynamic consistency of the ternary system data was also checked by the Margules three-suffix equation. The six constants obtained for the binary systems, together with a seventh constant for the ternary system, were employed. Activity coefficients calculated using these constants were compared with the experimental activity coefficient values and a reasonable agreement was observed.

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RATE OF MASS TRANSFER FROM A GAS STREAM TO A POROUS SOLID IN FLUIDIZED BEDS

(Publication No. 4936)

Cheng-Teh Hsu, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: MELVIN C. MOLSTAD

Rates of mass transfer at room temperature in the adsorption of carbon tetrachloride by activated charcoal in fluidized beds were measured. The diameter of the "reactor" used was 22 mm. I.D., the screen fractions of charcoal particles were 20-28, 28-35, 35-48 and 48-65 mesh, and the partial pressures of $CC1_4$ ranged from 0.052 to 0.317 mm. Hg. which were carried by nitrogen at a total pressure of about 1.1 atmosphere. In fluidized beds where the mixing of solids was complete, the overall mass transfer coefficient was found to decrease as the adsorbate content of the charcoal increased. A single curve is obtained for a given size of charcoal particle when the overall transfer coefficient is plotted against c/c_S, the ratio of the adsorbate content of the charcoal at any moment to the saturation capacity of the charcoal, based on the prevailing pressure of $CC1_4$ in the entering gas stream. When fresh charcoal particles begin to take on $CC14$, they behave like a non-porous solid and the gas film is responsible for the whole resistance to the transfer of mass. When correlated according to the method suggested by Gamson, the agreement between the results of the present work and the curve given by Gamson, based on the data of previous workers, is excellent. Fixed-bed mass transfer results for 20-28 mesh charcoal particles at different gas rates support the findings for the fluidized bed. In fluidized beds, the gas-film mass transfer coefficient is estimated to increase with the superficial gas velocity raised to the 0.2 power. The variation of the rate coefficients for diffusion inside the charcoal particles and for the activated adsorption with the carbon tetrachloride content of the charcoal is discussed.

Tables

1. Effective Solid Density of Activated Charcoal
2. Average Diameter and Bulk Density of Activated Charcoal Particles
3. Physical Characteristics of Activated Charcoal Particles
4. Fractional External Void in Fluidized Beds of Activated Charcoal

5. Equilibrium Adsorption of Carbon Tetrachloride by Activated Charcoal
6. Summary of Experimental Results
7. Summary of Calculated Results
8. Overall Mass Transfer Coefficient at $c/c_S = 0$ Based on the External Surface Area of Charcoal Particles of Different Mesh Sizes
9. Summary Calculations for $1/K_o$ and $1/u^{0.55}$ for 20-28 Mesh Charcoal Particles in Fixed Beds
10. Summary Calculations for Obtaining $j_d/(1-\epsilon)^{0.2}$ and $D_pG/\mu(1-\epsilon)$ in Gamson's Plot
11. Variation of Percentage Resistance Inside Charcoal Particles at Different Values of c/c_S

A1. Calibration of the Wet Test Meter
A2. Pressure Correction in the Reactor
A3. Calculation of the Variation of Gas Composition in a Series of Mass Transfer Runs
A4. Experimental Data of Run No. 210 and Calculation of Partial Pressure of $CC1_4$
A5. Calculation of Overall Mass Transfer Coefficient by the Average Method
A6. Calculation of the Overall Mass Transfer Coefficient by the Tangent Method

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CONTINUOUS FLOW STIRRED TANK REACTORS: SOLID-LIQUID SYSTEMS

(Publication No. 4865)

Robert Valentine Mattern, Ph.D.
University of Minnesota, 1952

The reactor system considered consisted of a baffled, propeller agitated reaction vessel with an open top into which flowed a liquid and an essentially continuous stream of solid particles. Steady state prevailed and the liquid, and for one method of operation the solid products, also flowed out continuously. With continuous flow of liquid, two methods of solid operation were examined in detail: an open solid, flow system where solid particles enter and leave the reactor continuously; and a choked solid, flow system where solid particles enter continuously but are prevented from leaving.

For solid dissolution processes, using both of the above mentioned methods of operation, analytical equations were developed which take into account most of the experimental factors such as flow rates. It was shown experimentally, using particles of sodium chloride and brine, that the rate coefficients obtained by the use of these theoretical equations were equivalent to those obtained by the use of simple overall rate equations based on an experimental measurement of the surface area of the solid in the reactor. The assumption that the surface areas of dissolving particles vary as the 2/3 power of their mass was experimentally verified. The measured surface area and size distributions of the outlet solid from an open solid, flow system agreed with those predicted by theory. The measured surface area of the solid in a choked solid reactor also agreed with theory.

The amount of solid in the reactor, expressed here in terms of α, the ratio of the liquid holding time to the solid holding time, was shown to vary widely with experimental conditions. By changing such design factors as the baffle position and the agitation level, the designer can more or less tailor the outflow conditions to meet his needs. However, at high solid rates or low liquid rates the reactor capacity can be reached and the unit overloaded with solid.

Extensions of the equations presented and the suggested methods of operation offer possibilities for the development of new reaction techniques in industrially important reaction processes.

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THE DESIGN, CONSTRUCTION, AND EVALUATION OF A CONTINUOUS PILOT PLANT HYPERSORPTION UNIT FOR THE VAPOR PHASE SEPARATION OF CARBON DISULFIDE FROM HYDROGEN SULFIDE

(Publication No. 4625)

Seymour Samuel Stein, Ph.D.
Virginia Polytechnic Institute, 1952

The purpose of this investigation was to design, construct, and evaluate a continuous, pilot plant, hypersorption unit, for the vapor-phase separation of carbon disulfide and hydrogen sulfide from mixtures of these substances.

Adsorption activity and retentivity tests were performed on activated carbon, activated alumina, silica gel, sovabeads, and filtrol to determine, based on single pass operation, the adsorbents which would adsorb large quantities of carbon disulfide, yet retain only small amounts. Activities of 59.40, 37.01, 23.56, 12.89, and 2.05 per cent, were obtained for activated carbon, silica gel, sovabeads, activated alumina, and filtrol, respectively, at 30°C and for an air flow rate of 1560 milliliters per minute. Retentivities of 2.93, 0.54, 3.05, and 3.65 per cent were obtained for activated carbon, sovabeads, activated alumina, and silica gel, respectively, at 30°C and for an air flow rate of 780 milliliters per minute.

Pure gas adsorption isotherms for carbon disulfide and hydrogen sulfide on activated carbon were determined. Isotherms were obtained at 33, 50, 75, 100, and 140°C for hydrogen sulfide, and at 50, 75, 100, and 140°C for carbon disulfide, at pressures of 11.4 to 726.0 millimeters of mercury. The dead space of the apparatus was determined with helium.

The experimentally determined isotherms were found to follow the general appearance of Type I isotherm curves. The ratio of carbon disulfide to

hydrogen sulfide adsorbed at a pressure of 760 millimeters of mercury, was 4.10, 6.08, 7.88, and 9.30 at temperatures of 50, 75, 100, and 140°C, indicating that the greater the temperature, the greater will be the preferential adsorption of carbon disulfide.

The adsorption isotherms of hydrogen sulfide were correlated as straight line logarithmic plots with the Freundlich adsorption equation, and the Williams-Henry adsorption equation permitted the correlation of the carbon disulfide adsorption isotherms as straight lines on a semi-logarithmic plot. Both curves were also correlated as straight line isosteres using Othmer plots.

Adsorption equilibrium curves for the system carbon disulfide-hydrogen sulfide were determined at 50 and 100°C. These curves expressed the unadsorbed vapor-adsorbate equilibrium data for hydrogen sulfide. These curves indicated that carbon disulfide was preferentially adsorbed on activated carbon from carbon disulfide-hydrogen sulfide vapor mixtures. The relative volatility of the system was found to increase with increasing temperatures. Increasing the adsorbent temperature from 50 to 100°C, resulted in an increase in the average volatility from 3.80 to 7.43.

The experimental hypersorber was designed and constructed based on modified data from commercial units. The hypersorption column was composed of two major heat transfer sections, consisting of vertical tube in shall exchangers, with a heat transfer area of 13.42 square feet, separated by adsorption and rectifying sections with sampling trays for the introduction and take-off of the various gas streams. The adsorption and rectifying section consisted of two inch standard pipe, and was 13 feet long. The over-all height of the unit was 30 feet. The components of the unit were assembled to form one vertical column with the cooler at the top and the heater at the bottom. A gas lift system was incorporated for circulating the carbon from the bottom of the unit to the top.

In the operation of the unit, the feed vapor rate was varied from 0.91 to 10.40 cubic feet per hour, the vapor concentration varied from 10.8 to 40.2 per cent carbon disulfide, and the carbon flow rate varied from 30.5 to 45.3 pounds per hour, at heater steam pressures of 9 and 90 pounds per square inch, gage, and cooler temperatures of 15.5 to 17.0°C.

It was found that carbon disulfide and hydrogen sulfide could be efficiently separated from vapor mixtures of these two substances in a hypersorption unit, using activated carbon. For the experimental conditions of operation, overhead product concentrations of 99.1 to 100.0 mol per cent hydrogen sulfide were obtained, with bottom product concentrations of 99.0 to 100.0 mol per cent carbon disulfide.

The attrition losses for the activated carbon in the hypersorber were very low. Starting with an average particle size of 1115 microns, 98 cycles of operation resulted in a decrease of 1077 microns.

The activity and retentivity of the activated carbon adsorbent decreased with column operation. After 98 cycles of operation, the activity, based on single pass operation, decreased from 70.3 to 58.3 grams of carbon disulfide adsorbed per hundred grams of carbon, and the retentivity decreased from 6.9 to 2.0.

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ENGINEERING, CIVIL

FILTRATION OF WATER THROUGH UNIFORM SAND FILTERS

(Publication No. 4864)

Joseph Tso-ti Ling, Ph.D.
University of Minnesota, 1952

This research is a basic investigation of the clarification of water by filtration through uniform sand. Particular attention has been devoted to the basic action of filtration within the filter bed and the effect of sand size, depth and filtration rate on the removal of turbidity. The change of loss of head during the filter run, the floc storage at successive layers in the bed and the economic comparison with the conventional graded sand filter were also studied.

The experiment was conducted in an experimental model which was designed to a complete small scale water filtration plant with rapid mixing chamber, flocculation basin, sedimentation tank, filters and accessories, etc. In order to obtain reliable and consistent data, all experimental procedures were standardized after a series of preliminary tests. Uniform sand of various sizes were studied under different filtration rates. A control filter of conventional 24" graded sand with effective size 0.5 mm, (uniformity coefficient 1.6) was tested in parallel to the uniform sand filter for comparison. Samples were collected at different depths from both filters during the course of filter run. The results from the limited tests conducted in this research are as follows:

1. The filtering mechanism in a uniform sand filter is similar to that in the graded sand filter. The upper portion of the bed performs most of the removal during the first part of the run. The removal burden is gradually transferred downward as the filtration continues. This basic mechanism is not affected by the variation in size of sand or the change in filtration rate.

2. When a clean filter is placed into service, the turbidity at any depth begins at a low value, and increases to a peak when the turbidity in the influent reaches the point of sampling. A greater peak value is obtained at high filtration rates. The filtering efficiency gradually improves after this peak, and the turbidity decreases to a minimum value as filtration continues. After this minimum value, the turbidity slowly increases until the filtration is stopped for back washing.

3. There was developed from this research the concept of equivalent depth which is defined as the depth of the uniform sand required to have turbidity removal and loss of head identical with the control filter under the same operating conditions. The equivalent depth increases as the size of sand becomes coarser, and is reduced when the filtration rate is raised. After a minimum value is passed, the equivalent depth gradually increases with the filtration rate.

4. The rate of change in head loss is approximately constant in both the uniform sand filter and the graded sand filter. Higher percent of loss of head was found at the top portion of a bed which was composed of fine sand or operated at lower filtration rate. About 20 to 50% of the total head loss is contributed by the top first inch of sand in the size range from 0.544 to 0.322 mm.

5. The length of the filter run (hours) varies directly as the 2.32 power of the sand size (mm), and inversely as 1.48 power of the filtration rate (gal./sq.ft./min.) in the uniform sand filter.

6. Based on equal turbidity removal with equal loss of head, the uniform sand filter could be operated at less cost than the graded sand filter under most conditions. The most economic uniform sand size determined by this investigation is 0.458 mm. The most economical filtration rate for this size is between 3.5 to 4 gal./sq.ft./min. At this economical combination, about $200 could be saved annually for each million gallons of water treated per day by employing a design using uniform sand media.

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ENGINEERING, ELECTRICAL

WAVE THEORY OF LOW FREQUENCY IONOSPHERIC PROPAGATION

(Publication No. 4657)

Shih-Chieh Chao, Ph.D.
Stanford University, 1953

In order to study the intensity and polarization of a downcoming radio wave reflected from the ionosphere, it is necessary to calculate the reflection and conversion coefficients at the boundary. Such calculations commonly proceed through the use of either ray theory or wave theory. At low frequencies, the ionosphere becomes a rapidly varying medium, and the assumptions of ray theory are no longer satisfied; it is then necessary to solve the field equations directly, as in wave theory.

This paper outlines the problem of electromagnetic wave propagation as affected by the presence of a horizontally stratified anisotropic ionosphere, reviews existing solutions of the problem, and offers extensions to the body of such solutions. The anisotropic properties of the ionosphere are discussed in terms of the dielectric tensor and its normal axes, by reference to which it is shown that magneto-ionic components can be identified only for the cases of longitudinal and transverse propagation.

Before undertaking a solution of the problem outlined, it is necessary to know or assume the variation of the parameters of the lower ionosphere. The vertical variation of electron collisional frequency is comparatively well established, but the same cannot be said of the ion density. There are indications that a fine structure of the lower ionosphere exists, but its detailed composition is not known. In view of this uncertainty, it has been necessary to consider only average layer characteristics, in the expectation that average reflection properties can be predicted therefrom, provided that an appropriate simple model is assumed. The measured data now available are insufficient to define such a model exactly, and it is to be hoped that with a knowledge of the differing results corresponding to various models of the lower ionosphere it will be possible to arrive at a satisfactory representation through further experimental measurements.

In this paper both homogeneous and linear models of ion density are employed. Since the penetration of long waves is small, it is reasonable to expect that it should be possible to use some such simple model to predict average propagation effects at low frequencies. A linear model appears to be the more logical approximation, since it avoids a discontinuity in ion density.

For practical applications, the case of a quasi-longitudinal geomagnetic field is important. At vertical incidence the polarization of reflected low frequency waves has been observed to be left-handed (in the northern hemisphere) and roughly circular, which is in agreement with theoretical calculations based on the ionization models employed in this paper. However it is found that wave theory calculations of the attenuation and time delay of the magneto-ionic components differ from the predictions of ray theory. Quantitative comparisons between the theoretical frequency variation of the reflection and conversion coefficients show that both homogeneous and linear models can yield much the same curves provided that the ion density and gradient are suitably adjusted. Observed conversion coefficient curves show lower values than those calculated using generally accepted values of collisional frequency, suggesting the possibility of an absorption region below the main reflection region. A difference is noted between the two models when at vertical incidence the geomagnetic field departs from the vertical, in which case the conversion coefficient for the homogeneous model becomes larger than for a linear model.

For oblique incidence, theoretical predictions show that the polarization of the downcoming wave approaches linear at very oblique incidence. The reflection coefficient increases with angle of incidence, while at the same time the conversion coefficient decreases rapidly for a linear model, but may increase

in a certain range of frequencies for a homogeneous model.

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THE RESPONSE OF SERVOMECHANISMS HAVING EXPONENTIALLY VARYING GAIN

(Publication No. 4660)

Percy Edward Alexander Cowley, Ph.D.
Stanford University, 1953

Exponential gain variations occur in closed-loop systems when for example the drive motor of an amplidyne system is connected to the line of supply. Similarly the gain in a hydraulic servo-system is dependent upon the speed of the pump motor, and the speed variation is again exponential at starting.

Systems having exponential gain variations are characterized by linear differential equations with non-constant coefficients; one or more of the coefficients include exponential terms. Attention is directed to the solution of the homogeneous differential equation to obtain the transient response since once the transient response is obtained, the response to a forcing function can be found.

The response of first, second and third order systems is discussed in some detail and examples of the transient response of typical systems is given. The transient response of first order systems is of the form:-

$$\theta = e^{-at} \cdot e^{b(1-e^{-\alpha t})}$$

The transient response of second order systems may be expressed in terms of Modified Bessel Functions of real, zero or imaginary order according as the system with full gain is overdamped, critically damped or underdamped. The form of the transient response is:-

$$\theta = e^{-\frac{B}{2J}t}\left[C_1 I_\nu\left(\delta e^{-\frac{\alpha}{2}t}\right) + C_2 K_\nu\left(\delta e^{-\frac{\alpha}{2}t}\right)\right]$$

where ν may be real, zero, or pure imaginary. Since Modified Bessel Functions of imaginary order are not tabulated they must be computed as required. As an aid to computation use is made of the forms of imaginary order Bessel Functions developed by Bocher for the solution of Laplace's Equation in Cylindrical Coordinates.

The general effect of the exponential rise of gain as compared with constant gain, is to increase the effective time constant of the system and in the case of second order systems to increase the transient amplitude. Most interesting, however, is the damping effect on the oscillations, in one of the examples reducing an oscillatory transient into a non-oscillatory transient.

The transient response of third order systems is obtained in series form. It is shown that for a servomechanism which is designed on the basis of the maximum peak response, the roots of the indicial equation are always of the same form, viz. one real root and one conjugate complex pair of roots. Two of the series are therefore complex but linear combinations are made to give two real independent series solutions. Convergence is rapid, so that only a few terms are required.

Systems which are characterized by a second order differential equation and are therefore covered by the second order case are:

(i) Regulators in which the important factors are the inertia, viscous friction and spring return force of the output member.
(ii) Servomechanisms in which the important factors are the output member inertia and viscous damping.

The third order case covers servomechanisms in which the important factors are the output member inertia and the constants of the controller, resulting in an open-loop transfer function of the form:-

$$KG(s) = \frac{K}{s(s^2 + 2D\omega s + \omega^2)}$$

Hydraulic servomechanisms in which the time constant of the stroke control may be neglected in comparison with the natural period of the system fall into this class. So also do amplidyne type servomechanisms in which the time constant of the control field may be neglected in comparison with the natural period.

The Ritz Averaging Method is applied to the solution of a conditionally stable system which is not amenable to the power series method because of slow convergence. However, the approximate solution so obtained contains an arbitrary coefficient which cannot be determined from the initial conditions, and much of the value of the approximate solution is lost. Suggestions are made for alternative approaches which may avoid the difficulty.

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ELECTROMAGNETIC ENERGY FLOW STUDIES AT LOW FREQUENCIES WITH PARTICULAR EMPHASIS ON ROTATING MACHINERY

(Publication No. 4930)

Edward I. Hawthorne, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: J. G. BRAINERD

The flow of energy in several electromagnetic devices, both stationary and involving moving parts,

is studied, with particular emphasis on rotating machinery: the d-c machine and the a-c synchronous machine, involving low frequency electromagnetic fields. Preliminary work, aimed at a most useful formulation of the problem, presented in appendices, consists of reviewing the basis of the concepts of non-electromagnetic and electromagnetic energy, and the criteria for and means of postulating corresponding energy flow vectors. In this connection the conventional Poynting's vector postulate is discussed as well as its commonly employed approximation, the V-I postulate, and applied to several simple situations. These postulates are then generalized by a formulation of other flow vector postulates, and including an "optimum" flow vector postulate, which differ from the Poynting's vector even in divergence, if electromagnetic energy postulates other than the conventional one are formulated. The occurrence of commonly questioned "paradoxes" resulting from the use of Poynting's vector is thereby clarified.

The conventional Poynting's flow vector is then employed for the purpose of tracing energy flow in stationary media; circuits, transmission lines, reactors, and the transformers. The applicability of the simplified V-I postulate and its limitations are demonstrated in the course of this study.

The flow of energy in rotating machinery is then studied in the main body of this paper, using certain engineering approximation procedures, valid under the low frequency field conditions, and employing the field theory approach in the analysis of the operation of the machine. The d-c generator is studied first under normal conditions, then loaded, using a simplified form of Poynting's vector to describe the electromagnetic energy flow, with certain components of it, which merely contribute to a local circulation of energy, omitted. The electromagnetic field in the conductors, in their vicinity and in the air gap are found. The flow of electromagnetic energy is formulated and traced within the conductors, in their vicinity, in the gap and towards the output terminals of the machine. Quantitative analysis in the region of the conductors and in the region of the gap is made. Energy balance at each step of the analysis is ascertained. The process of commutation, idealized for the purpose of energy flow within the machine, is shown to play a vital role in the flow of energy from the gap to the outward terminals. The flow of mechanical energy from the prime mover to the generator and the mechanism of its transformation into electrical energy at the current carrying conductors, are discussed in detail. Extension to other types of d-c machinery is discussed.

The flow of energy in an alternator is then studied. The problem is somewhat more complicated because of the time-varying nature of the electromagnetic field in the machine. Following the study of the unloaded machine, unity power factor loaded operation is analyzed. Again the complete electromagnetic field is found under somewhat idealized conditions. The appropriate components of Poynting's vector are then developed and employed to trace the electromagnetic energy flow from the conductors to the outward terminal. The analysis is quantitative in the gap and within the conductors and qualitative in the transmission region. The components of Poynting's vector, not included in the analysis, are shown to produce a local circulatory flow of energy. The general case of any power factor is then studied quantitatively, by breaking the field vectors into active and reactive components, and demonstrating that the reactive components result in circulatory flow of energy only. Extension to other types of a-c machinery is briefly discussed.

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TRAVELING WAVE AMPLIFICATION OF MILLIMETER WAVES

(Publication No. 4670)

Hubert Heffner, Ph.D.
Stanford University, 1953

An investigation of the helix and certain heavily loaded waveguides is made to determine their suitability as slow wave structures for millimeter wave amplifiers. Fundamental mode interaction in these circuits is found to be unsuitable because of the minuteness of the dimensions involved and the excessively close tolerances required in their construction. The periodically loaded guide is shown to exhibit space harmonics of the fundamental mode whose velocities may be made many times lower than that of the fundamental. Interaction with these space harmonics is investigated particularly with regard to the finned rectangular guide and is shown to lead to practical millimeter wave amplifiers if the impedance magnification around either the high or low frequency cut-off regions is utilized. The advantages of low frequency cut-off operation are pointed out. A detailed analysis of the expected gain in the vicinity of the low frequency cut-off including the effects of loss and space charge for the first space harmonic of the fin-opposite-fin and fin-opposite-slot corrugated guide is made. Interaction with backward waves is investigated and is shown to form a high gain, narrow band, regenerative-type amplifier and, at higher beam currents, a continuously voltage tunable oscillator suitable for use in the millimeter wave region. The start-oscillation conditions including the effect of space charge are quoted. The probable occurrence of backward wave oscillations in forward wave space harmonic amplifiers is pointed out and methods for their elimination proposed. The easitron, consisting of a resonant wall surrounding an electron beam, is analyzed and shown to form a high gain narrow band amplifier. Circuits of both cylindrical and rectangular geometry are proposed for millimeter wave easitrons and curves of expected gain are drawn. The problems of circuit excitation are pointed out. The results of a representative sample of nine experimental tubes of both the space

harmonic and easitron type are given and compared with the theory presented.

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SYNTHESIS OF DISTRIBUTED AMPLIFIERS FOR PRESCRIBED AMPLITUDE RESPONSE

(Publication No. 4683)

Arthur Donald Moore, Ph.D.
Stanford University, 1953

The purpose of this investigation is the development of synthesis techniques for distributed amplifiers in order to produce amplitude characteristics which approximate specified functions of frequency, using the concepts of modern network theory. Conventional distributed amplifiers are designed by an extension of the principles of image-parameter filter synthesis; this study shows that it is possible to combine the more effective insertion loss method of filter design with an iterative process to achieve prescribed amplitude characteristics for distributed-amplifier stages in specified circuit configurations.

The relationship between this problem and the more complete one of general active network synthesis is described. Amplifiers with resistively terminated ladder-like reactive structures in the plate and grid networks are analyzed. It is shown that the number of degrees of freedom available for approximation purposes in the gain function of a distributed-amplifier stage is usually less than the number apparent in the degree of the function. For this reason, it is generally impossible to match exactly an arbitrarily specified function of the same degree if the corresponding circuit is to be physically realizable. In order to satisfy the requirements of approximation and realizability simultaneously, an iterative procedure is introduced; variation of the gain function to meet each of the two requirements in turn produces a converging solution. Although no formal proof of convergence is given, the examples show that the method can give useful results after very few steps. The solutions are not unique; a number of discrete choices must be made during the design, so that a finite number of different circuits can be obtained, all in the specified configuration. Some of the available degrees of freedom are not used in the method and must be determined from other considerations.

Design techniques for maximally-flat and equal-ripple types of amplitude response are considered in detail. The maximally-flat specification is most easily satisfied; methods are described for numerous special cases, including some which reduce the number of choices which must be made. Modifications applicable to multi-stage amplifiers are described. Illustrative examples are presented for two- and three-tube stages in various configurations, with greatest emphasis on the maximally-flat designs. The principal difficulty in all cases is the necessary factorization of polynomials of high degree; suggestions for simplifying this problem are included. Although the principle remains the same for more elaborate designs, the numerical computation becomes excessive for the usual desk calculator.

For this particular form of active network, the iterative solution to the approximation and realization problems presents a new technique in network synthesis.

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PULSERS FOR THE STANFORD LINEAR ELECTRON ACCELERATORS

(Publication No. 4684)

Paul Alfred Pearson, Ph.D.
Stanford University, 1953

"Pulsers for the Stanford Linear Electron Accelerators" is a discussion of the requirements, developmental and engineering problems, and solutions for the klystron pulsers used with the 35 million electron-volt and one billion electron-volt linear electron accelerators at the Microwave Laboratory at Stanford University (the klystron amplifiers, which furnish radio-frequency power to the accelerators, number up to 22 for the larger machine, and each requires 400 kv, 100 megawatt, 2 microsecond, 60 pps pulses). Design procedures, specifications, and performance of the pulser components are given. It is written with sufficient completeness so as to provide a guide for any future development and to serve as a pulser instruction book for the users of the Stanford accelerators.

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ENGINEERING, MECHANICAL

THE HEAT TRANSFER AND FLOW FRICTION CHARACTERISTICS OF POROUS MEDIA

(Publication No. 4659)

Jack Edwin Coppage, Ph.D.
Stanford University, 1953

Convective heat transfer and flow friction data are presented for the flow of air through wire screen matrices and sphere matrices. The range of Reynolds numbers, based on a hydraulic diameter, covered was from about 5 to 1000. The data were obtained principally for closely packed wire screens,

covering a range of porosities from 0.60 to 0.83; data were also obtained for one separated screen matrix. The data for spheres were obtained for one randomly packed condition, the porosity being 0.39.

Based on the results of these experiments an empirical correlation of the heat transfer data is derived that covers the range of porosities from 39 to 83 percent. It is also shown that the results of previous investigators fit into this correlation quite well (± 25 percent). The flow friction data of both present and previous investigations is shown to fall into a ± 50 percent band using a single correlation, but this spread is too broad for technical usefulness. The band width of the flow friction data is found to be appreciably reduced when the porous media are divided into two classifications: (1) matrices composed of bodies having holes through them, and (2) matrices composed of aggregates of solid bodies with voids between; the resulting band widths for these two correlations are then ± 35 percent for each class.

The experimental technique employed for obtaining heat transfer data is the so-called "single blow" transient method. Using Schumann's analysis of heat transfer in an idealized porous medium the average heat transfer conductance can be deduced. With this method the matrix, initially at a uniform temperature, is heated by a stream of air entering at a uniformly higher temperature, and the exit air temperature is recorded as a function of time. This temperature-time curve is compared with Schumann's theoretical curves, and the average heat transfer conductance can then be determined.

The experimental method for determining the flow friction behavior is the usual steady state technique in which the pressure drop is measured under isothermal flow conditions and for essentially constant density flow.

Since the matrices examined in this study are well suited for use in the periodic-flow type of heat exchanger (similar to the common Ljungstrom air-preheater used in steam boiler systems) an investigation of the design theory of periodic-flow regenerators for gas turbine plants is presented. In addition a limited gas turbine regenerator design study is included to indicate the applicability of the surfaces tested. This study shows that periodic-flow regenerators employing wire screen matrices have smaller volume and weight than any designs heretofore considered.

Recommendations are made for future work in the direction of further verification of the proposed heat transfer correlation and for investigating the possibility of discovering a useful relation between heat transfer and flow friction behavior.

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ENGINEERING, MECHANICS

THE ELASTIC-PLASTIC BEHAVIOR OF RINGS

(Publication No. 4671)

Chintsun Hwang, Ph.D.
Stanford University, 1953

In this thesis the elastic-plastic behavior of circular and elliptic rings is studied. The cross-sectional dimensions of the rings are assumed to be very small compared with the radius of curvature of their centerlines, so that the stress distribution in the rings may be considered to be one-dimensional. Plastic collapse is first studied and is found to occur when a sufficient number of sections have yielded completely for the rings to behave as mechanisms. The mode of plastic collapse and the corresponding collapse load are studied using energy considerations. The discrepancy between safety factors based on the plastic collapse theory and safety factors based on the elastic theory are discussed.

In an elastic-plastic ring which has not yet reached its collapse stage, those parts which are plastic would yield freely if not contained by the still elastic portion of the ring. The corresponding deformations are called contained deformations. Ring segments are classified according to the type of stress distribution over the cross-sections. Solutions for the deformations of the various segments are found and are then matched to form a complete picture of the contained deformation of the ring.

If the ring is under repeated loading the effect of residual stresses must be considered. In this thesis the shakedown loads of thin rings, that is, the load under which the ring will behave elastically after a few cycles of loading, are discussed for various types of loading.

In the investigation previously described, the stress distributions in the rings have been considered to be one-dimensional in nature. When the rings are not very thin, however, the stress distribution must be considered to be a two-dimensional one. The two-dimensional elastic-plastic plane-stress distribution in a semi-circular bar subjected to bending moments and equal and opposite shear forces applied to its end section is analyzed with the aid of several simplifying assumptions. By assuming the maximum shear stress theory to describe yielding in the plastic zone and Hooke's law in the elastic zone, the stress distribution is determined by means of equilibrium relations between the stresses. The stress distribution thus obtained is expected to be a fair representation of the stresses in a circular ring under two equal and opposite diametral forces except near the points of application of the forces.

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AN ANALYSIS OF LATTICED BEAM-COLUMNS*

(Publication No. 4686)

Hassel Charles Schjelderup
Stanford University, 1953

Flexural members composed of flanges held together by lacing or batten bars in place of a solid web are much used in engineering structures. Such members subjected to combined axial and lateral loads present an unusually difficult problem of analysis. Studies based on replacement of lacing by an equivalent solid web may give some indication of the overall behavior of the member, but leave much to be desired in regard to the nature of local stresses and general adequacy of various lacing systems. This dissertation constitutes a study of the behavior of laced members using a method of difference equations.

Difference equations are derived and applied to a general analysis for stresses and deflections of latticed beam-columns. Various lacing systems are compared with the result that double-diagonal systems were found to be better than single diagonal systems. Experimental verification of the general theory is made by comparing results obtained from equations for stress and deflection with results obtained from experimental data. Correlation is good.

Equations for Euler Critical Load are derived and found to be in good agreement with those derived by other authors.

Local stress conditions are investigated in order to compare these stresses with primary stresses. In particular the influence of pantographic action was studied. That is, secondary bending in the flanges caused by restraining tie or stay plates. For chosen examples, this action was found to produce stress up to and greater than thirty percent of the primary axial stress. These values of stress magnitudes are in good agreement with experimental values. From the results of this study, it was suggested that tied lacing systems were superior and should always be used for main members. The effects of eccentric connections were discussed and approximate equations from which to compute effects were listed.

Finally, stiffness and carry-over factors as used in moment distribution were derived from the various systems and their variation with axial load discussed. For a chosen example, shear distortion was found to reduce both stiffness and carry-over factors by approximately twenty percent as compared to those for an equivalent solid beam.

*Dissertation prepared under the direction of Professor J. R. Benjamin and Professor D. H. Young.

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ENGINEERING, METALLURGY

THE WETTING OF SOLID METALS BY LIQUID LEAD AND BISMUTH

(Publication No. 4666)

Edward Perry French, Ph.D.
Stanford University, 1953

The liquid-solid contact angle is adopted as the measure of the degree of wetting. A solid metal is considered to be wet by a liquid metal if a contact angle less than 90^0 is formed.

Experiments are described in which samples of type 446 stainless steel, molybdenum, tungsten, tantalum, columbium, titanium, zirconium, and cobalt were heated in contact with liquid lead and bismuth inside evacuated Vycor capsules. In all cases wetting occurred when the testing temperature was sufficiently high.

The effect of oxidation on wetting is considered. Cups of type 446 stainless steel, containing liquid lead or bismuth were heated to various temperatures in the range 1000^0F. to 1600^0F. Contact angles were found to decrease as the testing temperature was raised. In the case of lead, tests carried out using bright steel and pure liquid metal resulted in lower contact angles than those found when either the liquid metal or the steel had been oxidized. In the case of bismuth, no correlation between degree of oxidation and contact angle was found.

Contact angles of liquid-metal drops, heated in vacuum on the polished surfaces of solid-metal samples, are reported. For lead and bismuth on SAE 1010 steel the angles decreased regularly with testing temperature, from more than 120^0 at 800^0F. to 20^0 - 40^0 at 1200^0F. Contact angles for lead and bismuth on type 446 stainless steel, for bismuth on nickel, and for lead on magnetite are also reported.

The contact angles formed by liquid-metal drops at a given temperature can be considerably lowered in the case of SAE 1010 steel and tantalum, by prior vacuum heating of the solid metal. This treatment is believed to remove surface oxide from the sample surface.

Experiments on the removal of visible oxide films from SAE 1020 steel by vacuum heating indicate that the carbon present in the steel reduces the iron oxide, producing carbon monoxide. The rate of gas evolution is slow below 1350^0F., moderately rapid between 1350^0F. and 1650^0F., and very rapid at 1750^0F.

The design and testing of a device for determining contact angles existing at metal surfaces beneath a liquid-metal bath, is described. An equation is derived, from which measurements with the device can be expressed in terms of contact angles.

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THE PLASTIC DEFORMATION AND RUPTURE OF PURE GOLD

(Publication No. 4682)

Donald Richard Mash, Ph.D.
Stanford University, 1953

Pure gold, 99.999 per cent, was employed as the test material in the investigation of the nature of the intercrystalline deformation and rupture of metals under prolonged loading at relatively high temperatures. Primarily, creep-rupture behavior of .1010 inch diameter specimens was investigated in air, under constant load, for a number of strain rates at 800°F., 1250°F., 1500°F., and at 1650°F. In addition, short time tensile tests were carried out over the range from the ordinary temperature to 1500°F. The test material exhibited normal, ductile behavior at all temperatures under the very rapid strain rates. Under prolonged loading in creep-rupture, intercrystalline deformation and rupture was clearly observed, indicating the truly inherent nature of such behavior in metals. This was further confirmed, in the present case, by testing a pure gold specimen in vacuum. Microstructures varied from very fine-grained (.03 mm.) in the 800°F. tests to extremely coarse, mixed-grained structures at 1500°F. and higher. Recrystallization was found to play an important part in the creep and rupture of the 800°F. tests which exhibited intercrystalline fracture after a creep-rupture life of only 51 hours. At the higher temperatures, individual grain orientation and the distribution of grains were important; completely intercrystalline rupture was not obtained until extremely low strain rates were employed. At 1500°F., a time to rupture of about 2000 hours was required before such behavior was observed. No change from a flatter to a steeper slope in the straight line log-log plot of stress versus time to rupture or minimum creep rate was found. The temperature coefficient of the minimum creep rate was observed to be markedly stress-dependent. The concept of equicohesion appeared to be of no help in the present investigation, either in predicting or in explaining results. At stresses normally employed in creep-rupture testing, consideration of the processes at work within the crystals themselves, and the influence of such variables as grain size and strain rate on these processes, is suggested as the most useful means of predicting intercrystalline behavior. Considering the grain boundaries as potentially always the weakest regions of the metal structure, intercrystalline deformation and rupture is seen as a natural consequence of conditions which favor a minimum amount of individual crystal distortion. From the present study, either very low strain rates or recrystallization were observed to be necessary requirements for such behavior.

The internal friction and rigidity of pure gold were studied as a function of temperature by means of a torsion pendulum at frequencies of about 1 cycle per second. Above an annealing temperature of 1000°F., an internal friction curve possessing two maxima was obtained. This "double peak" phenomenon was clearly associated with the "secondary" recrystallization of the specimen. Two widely different values of energy of activation were obtained for the two peaks, varying from 34,500 cal./mol. for the lower temperature peak to 58,000 cal./mol. for the higher temperature peak. Commercially pure, 99.98 per cent, gold wire did not exhibit this effect, possessing only a single peak. A single crystal specimen showed no peaks, but was greatly influenced by pre-test cold work. Consideration of the possible sources of the double peak phenomenon indicated that viscous grain boundary slip was the most likely. However, the importance of small amounts of impurities is pointed out, as well as the dependence of activation energy upon grain size. This latter fact would indicate that the use of discrete values of activation energy for grain boundary slip as a basis of comparison with other processes, such as volume diffusion, is of questionable value.

In addition to the foregoing, a comprehensive summary of the historical background and review of the literature regarding the creep and rupture of metals at elevated temperatures is given.

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EQUILIBRIUM STUDY OF THE Fe-S-O SYSTEM FROM 1555° TO 1645°C

(Publication No. 4946)

James Lewis Nichols
University of Pennsylvania, 1953

SUPERVISOR: FRED J. DUNKERBY

The reaction of SO_2 gas with molten iron was investigated from 1555° to 1645°C using a flow-type apparatus. At 1600°C, an equilibrium constant of 0.921×10^3 was found for the reaction $SO_2(g) = \underline{S}$(% in liq. Fe) + $2\underline{O}$(% in liq.Fe) with a corresponding relation of K with temperature of

$$\log K = \frac{-9563}{T} + 8.063$$

The standard free energy change for the above reaction was found to vary with temperature in the following manner:

$$\Delta F^0 = 43{,}800 - 36.9\,T$$

Assuming the Van't Hoff equation to hold over the small temperature range of 1555° to 1645°C, a heat of reaction, ΔH, of 43,800 cal./mole was found for the reaction.

The effect of sulfur on the solubility of oxygen in liquid iron at 1625°C was also investigated within the range of nil to 0.2 per cent sulfur. The oxygen solubility showed a decrease up to 0.1% sulfur and then a rapid increase.

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THE EFFECT OF GRAIN SIZE AND CARBON CONTENT ON THE LOW TEMPERATURE TENSILE PROPERTIES OF PURE IRON: CARBON ALLOYS

(Publication No. 4949)

Raymond Lloyd Smith, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: R. M. BRICK

Several low carbon ferrites, approximately 99.9% pure apart from the alloying element, were prepared and tested in tension under various conditions of heat treatment, ferrite grain size, and test temperature. True stress-strain curves were calculated and the significant tensile parameters evaluated. The effect of ferrite grain size on the total strain, yield point, and exponent of strain hardening was determined at liquid air temperature. The variation of the exponent of strain hardening with changes in carbon content and temperature was evaluated. The scatter of yield point data when plotted as a function of grain size was shown to be explicable in terms of substructure.

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FLOW AND FRACTURE OF SINGLE CRYSTALS OF HIGH PURITY FERRITES

(Publication No. 4950)

Roelof P. Steijn, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: R. M. BRICK

Flow and fracture studies at room and sub-zero temperatures were conducted on single crystals of two high-purity titanium ferrites of .1 and .3% Ti and on one high-purity iron-carbon alloy of .023%C.

The flow studies consisted of tension and compression tests. Microscopic determinations of the slip elements from surface markings were correlated with X-ray examinations. A slip mechanism was found confirming Taylor's early viewpoint of so-called "non-crystallographic slip." Comparison between compression and tension data indicated a fundamental difference with respect to the glide plane selected which shows that the normal stress is significant.

Slip on high indices planes was visualized from a model which considers the atoms as hard spheres. A general theory was presented to explain slip in b.c.c. metals and alloys. A new method was developed for the analysis of asterism found in Laue photograms.

Fracture tests were carried out at a number of sub-zero temperatures. A strong dependence of the ductility on the temperature and the crystal orientation was found. The variation of the critical shear stress for slip with temperature, down to -150°C, was found. Mechanical twinning was encountered at -75°C and lower. The concept of a critical resolved shear stress for twinning could not be substantiated.

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ENGINEERING, MINING

EFFECT OF FREE GAS SATURATION ON OIL RECOVERY BY WATER FLOODING

(Publication No. 4662)

Mohamed Husni Morad Elbishlawi, Ph.D.
Stanford University, 1953

A vast amount of research has been directed in the past toward the study of the many factors affecting water flooding operations. One of these factors and the subject of this investigation is the study of the effect of free gas in the presence of an interstitial water saturation upon oil recovery by water flooding.

Previous workers have not used natural crude oils or brines in their research. In an effort to more nearly simulate field conditions within the cores, a live natural crude was used for saturating the cores in the present study. In addition, a natural brine was used for interstitial water content and for flooding. Both the crude and the brine used came from the Kettleman Hills oil fields.

Two cores of widely different characteristics were tested. They were an unconsolidated sand packed column and an oil field core of First Venango sandstone from Pennsylvania.

Different free gas saturations were established internally in the unconsolidated sand core by reducing the pressure on the core after being saturated with live crude. In the case of the Venango sandstone core, different free gas saturations were obtained by capillary displacement of the oil-saturated core by nitrogen gas.

Water flooding of both cores was conducted at a constant temperature of 90°F. The fluid contents of the cores before and after flooding were calculated by the volumetric material balance method. Flooding was continued in each test until a water to oil ratio of 50:1 was produced.

Six floods were made on the unconsolidated sand core and three on the Venango sandstone core. A relationship in which a reduction in residual oil saturation below that obtained when flooding the same system in the absence of free gas was found in both cores. Higher oil recoveries and lower residual oil saturations were obtained by increasing the initial free gas saturation. The total reduction in residual oil at the highest gas saturation used in the

unconsolidated sand core (25.5 per cent) was 17.7 per cent of the pore volume. In the case of the Venango sandstone core (26.2 per cent free gas saturation), the total reduction in residual oil amounted to 19.9 per cent of the pore volume.

The above relationship was checked theoretically for the unconsolidated sand core by means of Pirson's simplification of the frontal drive method of Buckley and Leverett. Leverett and Lewis' relative permeability curves for unconsolidated sands were used in the above calculations.

The close check between the experimental and the theoretical trend of the residual oil-free gas relationship in flooding the unconsolidated sand core leads to the conclusion that the effect of free gas on oil recovery by water flooding may be mainly attributed to the partial replacement of residual oil by free gas combined with a reduction in the permeability to oil.

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GEOLOGY

GEOMORPHOLOGY OF THE FAIRBANKS AREA, ALASKA

(Publication No. 4685)

Troy Lewis Péwé, Ph.D.
Stanford University, 1953

The frozen silts of the Yukon-Tanana Upland in the Fairbanks area, Alaska, reveal a complex history of erosion, deposition, freezing, and thawing during the past 20,000 years. The fossil fauna and flora provide valuable information on geologic and geographic range of the species, and cast some light on environmental conditions. Creek gravels permit projection of the regional history back to possibly early Quaternary.

The southern half of the Fairbanks area lies in the Tanana Valley, a broad lowland between the Alaska Range on the south and the Yukon-Tanana Upland on the north. The northern half is an area of rounded schist hills. Broad sediment-filled valleys separate the rounded hills, which are blanketed with a silt cover 10 to 200 feet thick.

The silt of the Fairbanks area is eolian, and represents two or more periods of loess deposition. The material was derived from the floodplains of the Tanana River and glacial streams issuing from the Alaska Range. Episodes of loess deposition are tentatively correlated with Wisconsin glacial advances in the Alaska Range near Big Delta, 70 miles to the southeast. The earliest loess was deposited on bedrock hills and on a thin organic silt layer (muck) in valley bottoms below. This muck is more than 20,000 years old (radiocarbon).

Much of the loess and many vertebrate remains were carried into creek bottoms by wash and mass-wasting. With abatement of loess deposition in this area, and withdrawal of glaciers in the Alaska Range, streams began down-cutting. Creeks from the Yukon-Tanana Upland cut headward, removing much of the fossil-bearing loess from valley bottoms.

A thick muck layer was deposited in valleys carved in the fossil-bearing loess. The muck, which represents slope wash and soil creep from adjacent slopes, was deposited sporadically and entombed forests, pond deposits, and vertebrate remains. Radiocarbon analyses of organic material reveal an age of 13,600 years.

Some of the extinct species of vertebrate remains concentrated in the muck are bison, mammoth, horse, lion, camel, sloth, giant elk, musk ox, bear, mastodon, and antelope. A few incomplete carcasses still show hide, hair, and occasionally flesh. The preservation is probably due to burial in cold moist organic silt and peat and to subsequent freezing. Before the ground became frozen, however, water percolated through the muck into the underlying loess. The water reduced the ferric compounds of the loess to ferrous, changing the color of the silt to green.

After deposition of a large part of the muck, the muck, loess, gravel, and in places bedrock became frozen. Much of the permafrost in the Fairbanks area today is thought to date from this freezing.

As the ground became frozen, most of the water was converted into interstitial ice and small clear-ice segregations. During freezing, or after the ground had become permanently frozen, large "foliated" ice masses, mainly wedges and other cross-cutting bodies, grew slowly in frost cracks.

This permafrost-forming period was also the time of increased loess deposition and advance of glaciers. Subsequently, some of the muck and ice was eroded from creek bottoms. Tops of many ice wedges melted down 2 to 5 feet.

Much slope wash produced during this short warming period was deposited as a thin muck layer on top of the remaining older muck in creek bottoms. No bones of extinct mammals are known from this late muck 4,200 years old (radiocarbon). This deposit has become frozen, but contains no large ice masses. Permafrost is forming today in fine-grained sediments of creek bottoms.

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HISTORY, GENERAL

SEVENTEENTH CENTURY SCIENCE AS A PRODUCT OF EUROPEAN UNIVERSITIES

(Publication No. 4852)

Glen R. Driscoll, Ph.D.
University of Minnesota, 1952

This thesis examines how and to what extent universities and university scholars of the seventeenth century contributed to European scientific progress. Writers in the intellectual history of this period have previously assumed that European universities stubbornly retained their medieval scholastic traditions throughout the century, and even struck out in vigorous opposition against the new scientific attitudes and discoveries. This thesis presents evidence which demonstrates that the European universities contributed materially to the progress of seventeenth century science through a determined empirical approach.

The writer of this thesis has examined the seventeenth century history of major universities in England, the Lowlands, France, the Germanies, and Italy. The quality and quantity of scientific vigor and skill found in the universities studied has been compared with extramural European scientific study. University statutory provisions for scientific training have been cited wherever available. However, the major source of information for this work has been the professional interests and private lives of scientists teaching or studying in European universities. Memoirs, correspondence, and professional works have revealed, in many instances, that scientific programs in universities were often far in advance of statutory limitations. Recent periodical and other literature — technical, biographical, and interpretative — has also been consulted.

The writer of this thesis is not a scientist. Therefore, he has made no attempt to evaluate technically, or to discuss in professional terminology, the scientific achievements of this century. This work will, however, make it possible for future scholars to discuss the intellectual atmosphere of the seventeenth century more accurately. The part played by university scholars in exploring the frontiers of scientific knowledge is illustrated for the first time.

On the basis of his research, the author of this thesis has concluded that scholars in European universities did much to make the seventeenth century an "Age of Science." Such famous scientists as Galileo and Newton accomplished significant work in their capacities of university professors. By the end of the century many universities afforded considerable training in mathematics, physics, astronomy, botany, anatomy, physiology, pathology, and chemistry. The latest techniques and scientific instruments were employed by university professors. Many of the famous scientific academies and societies of the century were founded as a result of the work of university men. Basic scientific laws were discovered by men doing research in universities; and these laws, in turn, were often demonstrated in a university laboratory, observatory, amphitheater, or classroom. In short, European universities did not lag behind or rebel against discoveries in the sciences. To the contrary, they contributed immeasurably in making the seventeenth century one of the most illustrious periods of scientific productivity that the world has known.

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HISTORY, ANCIENT

CUNEIFORM TEXTS FROM TELL BILLA

(Publication No. 4922)

Jacob J. Finkelstein, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: E. A. SPEISER

The cuneiform tablets here published were found at Tell Billa, a large mound about fifteen miles northeast of Mosul in Iraq. The excavations at the site were conducted by the American Schools of Oriental Research and the University of Pennsylvania Museum during the years 1930-1934.

The site can be positively identified with ancient Shibaniba which was known to be a provincial center during the late Assyrian Empire. The information given by the tablets from Tell Billa indicate that the town had already achieved such a position as early as the thirteenth century B.C. The tablets from Billa represent two archaeological levels from the site, the earlier, known as Middle Assyrian, dating to the thirteenth century B.C., and the later, known as Late Assyrian dating to the early part of the ninth century B.C. The dates for both groups of texts are established by the eponyms occuring in them which have been known previously.

The Middle Assyrian tablets from Billa are primarily of an economic and legal nature, dealing with loans and receipts for lead, the basic metal of exchange in Assyria, barley, wheat, emmer, as well as sheep and wool. Administrative documents, which constitute a sizeable proportion of the tablets from this period, deal with similar subjects, thereby amplifying a statement by Sennacherib in the seventh century B.C. which implied that Shibaniba was an important center for trade in sheep and grain. The town probably served as the central marketing point for the flocks from the Kurdish mountains, and from which point they were funneled to Nineveh, the capital of the empire, about fifteen miles to the south on the Tigris.

Other tablets from this period include a small amount of correspondence between some public officials, lists of troop levies and their officers in charge, lists of towns from which sheep were collected, probably as taxes, lists of individuals, and lexical texts, the largest of which is an important list of domestic animals and is entirely in Sumerian.

The significance of the Middle Assyrian tablets from Billa lies in the fact that aside from royal annals, the period is represented epigraphically by only a few hundred economic and legal texts from Ashur, the capital of the empire at that time. The material here published therefore adds appreciably to the fund of information regarding the economic and administrative affairs of Assyria for this period, which was the time of the first great expansion of the empire.

The ninth century B.C., the date of the second group of tablets from Billa, has heretofore been even less adequately represented than the earlier period. The Billa tablets from this period are almost exclusively administrative in character, and date for the most part to the reign of Shalmaneser III and his predecessor Ashurnasirpal II, both of whom waged wars throughout their entire reigns, and represented the second great period of expansion of the Assyrian Empire. The Billa tablets cast light on the methods of mobilization of the country's resources necessary for these extensive military operations. The texts deal again with troop levies, and also with musters of horses, donkeys, and mules. Others deal with collection of taxes, usually in grain, assessment of estates, probably for tax purposes, and lists of cities from which sheep and fodder had been collected or from which such collections were due. Another important text from this group is a register of individuals in various professions which reflects the range of activities pursued at Shibaniba in the ninth century B.C. Many of these were cult personnel, thereby confirming the existence of an important temple at Shibaniba during this period which was indicated by the architectural remains at the site.

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HISTORY, MODERN

COTTON MATHER'S KNOWLEDGE OF MEDICINE

(Publication No. 4895)

Otho Thompson Beall, Jr., Ph.D.
University of Pennsylvania, 1952

SUPERVISOR: THOMAS P. HAVILAND

An appraisal of Mather's medical writings demonstrates that he possessed a medical background acquired over many years, that he has no rival during the colonial period in the number of medical titles which he published, that he is apparently the first writer in America to have produced a general treatise on medicine, and that he is one of the first Americans to have demonstrated a knowledge of the animalcular theory of disease.

Biographical facts about Mather indicate an interest in medicine probably at the age of ten or eleven when an impediment in his speech caused him to fear that he would be unfitted for the calling of a clergyman. During his period of indecision, he studied physic with great application, apparently by reading, this being the accepted method of study.

Mather's interest in medicine persists throughout his writings, combined with, yet subordinate to, his chief interest, religion. The "Biblia Americana" and the Magnalia clearly illustrate this point. The "Curiosa Americana" contain many letters on medicine and its allied aspects. Mather's Diary records a growing desire to be of public service in a medical capacity. Less important references to medicine appear in his sermons.

Mather acted three times in matters of public health. During the smallpox epidemic of 1702 in Boston, he introduced Sydenham's method of managing the disease. In 1713 he published an anonymous four-page pamphlet on the best treatment of measles. His introduction of inoculation for smallpox in 1721 thus appears in a new light in consideration of his many years of medical training and of two previous similar public actions.

At the outbreak of the inoculation controversy Mather was writing his large medical treatise, "The Angel of Bethesda." This work is unique in presenting an integrated system of medicine; its scope is such that it deals with disease from a religious, philosophical, and practical point of view. His religious theory of disease is that it is caused by original sin; his practical theory is basically Hippocratic in that it follows the classical theory of humors and fluids. Yet Mather protests against the contemporary confusion in the theory of disease.

Mather's presentation of the animalcular hypothesis is a conjectural one, but one which "may be as good as many that have been more confidently obtruded and more generally received." A cornerstone of Mather's medical theory is the presentation of a vitalistic theory.

His theory of therapy includes the medicinal and the non-medicinal. His pharmacopoeia quotes both the mineral and botanical remedies of current English and continental pharmacopoeias. Transplantation, as in the case of smallpox, is the most widely discussed of his therapeutic hypotheses. His non-medicinal therapy recognizes the importance of emotional states as a major factor in recovery. Mather also theorizes on the medical aspects of the occult world.

Mather appears in his typical aspect as the disseminator of medical knowledge, which often appears to have been more advanced than than of the Boston physicians. The distinction between Mather as a man of medicine and the professional physician of his time becomes a subtle one, for by "reading medicine" Mather had also fulfilled the prime requisite of medical training. "The Angel of Bethesda" reflects

perhaps the best expression of the attitude toward medicine of the intellectual classes in colonial New England. This work is the only general medical treatise written in America prior to almost 1800. Mather is the first significant figure in American medicine.

Microfilm copy of complete manuscript of 279 pages, $3.49. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-416.

JAPAN'S DECISION TO SURRENDER: A STUDY IN POLICY EVOLUTION

(Publication No. 4656)

Robert Joseph Charles Butow, Ph.D.
Stanford University, 1953

Japan's formal acceptance of the Potsdam ultimatum on August 14, 1945 represented much more than just a hasty reaction to the atomic bomb and the Soviet Union's entry into the war. The capitulation was actually the climax of the behind-the-scenes activities of those Japanese whose thoughts and actions spawned Japan's decision to surrender. This study is a history of those activities and an investigation of that decision.

The narrative begins with the early months of the military's gamble at conquest, keeps pace with the successive crises growing out of Japan's mounting defeats, and terminates with the unprecedented developments which keynote the last fateful days of Japan's tragedy.

The failure of the Empire's strategic planning, the nature and effect of Japanese psychology, and the limitations imposed by an insidious system of thought control set the stage upon which the rise and fall of cabinets, the interplay of power groups within the circle of the ruling elite, the part played by the "senior statesmen," the role of the Supreme Council for the Direction of the War, and the machinations of the military services are all meaningful elements in the gradual emergence of a policy decision which spelled the difference between survival and destruction.

The development of schemes to negotiate a settlement favorable to Japan, the launching of "peace" feelers in Sweden and Switzerland, the quest for Soviet aid and later for Soviet mediation, and the final reliance upon the influence of the Emperor and the Throne record the steps by which the more alert members of the ruling elite committed the Japanese government to salvaging, through negotiation, a part at least of what the military had failed to attain by force of arms. The internal obstacles encountered by the end-the-war advocates and the external problems posed by Allied policy pronouncements figure both as incidents in the story behind Japan's surrender and as examples of the difficulties experienced by those who had to choose between war and peace.

The material upon which this study is based falls within these primary groupings: records, exhibits, and proceedings of the International Military Tribunal for the Far East; documents in the possession of and investigations undertaken by the Japanese Ministry of Foreign Affairs; unclassified and unpublished files of the United States Army; and personal interviews of the principals conducted by the author in Japan during 1951 and 1952.

Microfilm copy of complete manuscript of 565 pages, $7.06. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-417.

ATTEMPTS TO CONFEDERATE THE STATES OF CENTRAL AMERICA

(Publication No. 4673)

Thomas Lindas Karnes, Ph.D.
Stanford University, 1953

Among Central American writers and political leaders there is no topic which has provoked such enduring interest as that of confederating the nations of Guatemala, Honduras, El Salvador, Nicaragua and Costa Rica. In 129 years of republican existence there have been more than a score of attempts to place these states under a single government. The plans drawn up have varied in framework from the weakest type of confederation to a centralized union with existing boundaries destroyed. All of the efforts have failed. Nevertheless, in 1952 government leaders from all of these republics are again engaged in conversations whose goal is confederacy.

Initially the justification for closer ties in Central America, as elsewhere in Latin America, was sought in the area's colonial experience. Realistic leaders, always a minority in Central America, were soon awakened to the facts. Three hundred years of centralized government, a common racial background of the ruling class, and a common religion had not produced an adhesive force sufficient to counteract the results of political inexperience, local pride exaggerated by an inadequate transportation system, and self-determinism in economic matters.

The sheer resoluteness of a very few men, outstanding of whom was Francisco Morazán, held the region together in a confederation from 1823, when it separated from Mexico, until 1839. By that time all of the forces which have kept Central American states from forming a lasting political union had reared their heads. No nation or group of nations, no leader or group of leaders, has since had the military strength or respect to weld together the diverse geographical areas, economies and racial mixtures of the five nations, or to overcome the petty jealousies of politicians at times encouraged by foreign powers.

In spite of this background of chronic failure there are now some brighter prospects for confederacy. Central America today, unlike at certain earlier times, may expect encouragement and assistance from other important nations of the Hemisphere in working out a union. As transportation and communication facilities improve the various

nations may be expected to be drawn closer together. Much of the bitterness of the past seems to have been forgotten. Though it is unlikely that any political confederation can succeed in the immediate future, there still exists among many Central Americans the fervent desire to unite themselves in a greater republic. So long as men have this dream the possibility is not dead.

Microfilm copy of complete manuscript of 281 pages, $3.51. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-418.

THE JACOBEAN EPISCOPATE AND ITS LEGACY: A STUDY OF THE EPISCOPACY IN CANTERBURY AND YORK DURING THE REIGN OF KING JAMES I

(Publication No. 4893)

Arthur Philip Kautz, Ph.D.
University of Minnesota, 1952

In 1641, but sixteen years after King James' death, episcopacy and the English episcopate were weighed and rejected. Why?

The Jacobean roots of the tragedy lay not only in the policies and procedures of King James I, but of the entire episcopate. The initial responsibility of the King lay in his failure to formulate and follow a definite policy in selecting bishops and archbishops for the Church. Into the episcopate came "all sorts and conditions of men." They were drawn from diverse geographical areas and social strata. Their academic records were uniformly high. But where perfection was required, the bishops' wives were imperfect; not always did the bishop "have his children in subjection with all gravity"; in their ministerial backgrounds, some of the bishops were considered novices; where perfection was required, the sixty-six prelates met, avoided, attacked and ignored their variety of duties, challenges, and opportunities, as all sorts of conditions of men in their several stations are wont to do.

Because there was no consistency in the policy of selecting bishops, there could be no uniform voice of the Church in matters of doctrine and practice. But matters of doctrine and practice were at the time being refined in English and Continental fires of orthodoxy, especially at the Synod of Dort in 1618-1619. By their actions and inactions in the political, ecclesiastical, and recusant areas, the bishops caused religious and political dissent in England to burgeon and grow. Within the Church, in an age of extremes and growing dogmatism, episcopal councils divided over the definition of "Christs holy Catholic Church."

The division in episcopal councils, however, was but a reflection of an irreconcilable conflict growing in English political, economic and cultural, as well as ecclesiastical life. For the King and his divided episcopate were caught in a stream of historical forces unleashed long before the Stuarts came to the English throne. Had the bishops been the wisest and ablest of men, they could not but have fallen short of the ideals presented by a generation of men who dreamed dreams and saw visions. Because some bishops had not walked circumspectly, but had erred, and because a faction had joined the Crown in a powerful religious, social, political union, the entire episcopate and episcopacy fell under like condemnation.

The final responsibility of the King lay in providing the flashpoint for the popular dissatisfaction with the Church. Over the protests of his Archbishop of Canterbury, the senile King James I encouraged Richard Montagu, rector of Stanford Rivers, Essex, to write a book, Appello Caesarem. The explosive book unwittingly became the King's ecclesiastical last testament.

The crusade of 1641 was a simple Puritan solution to the complex problems raised by ideological unrest and the disintegration of the times; by the answers which King James, a King whose ecclesiastical pretensions far outweighed his achievements, gave or failed to give to the questions of the Church; and especially by the division in the Jacobean episcopate over Church fellowship and unity, over Christian doctrine and practice, over the very basis and validity of the ministry, over historical outlook, and, perhaps coincidentally, over political behavior. Of the episcopate chosen to "uphold and maintain the government of the late Queen, as she left it settled," such was the legacy.

Microfilm copy of complete manuscript of 252 pages, $3.15. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-419.

HERDER AND THE FRENCH REVOLUTION

(Publication No. 4675)

Samson Benjamin Knoll, Ph.D.
Stanford University, 1953

Social origin and intellectual development had prepared Johann Gotfried Herder (1744-1803) to meet the French Revolution with sympathy. By birth and conviction he was a member of the middle class. His consciousness of civic freedom had been awakened by his experiences in Riga. By contrast, service at the absolute, though enlightened, Weimar court had confirmed his hatred of absolute rule.

A decisive fact was that before the outbreak of the Revolution Herder had already formulated his theory of history. This theory was evolutionary; it therefore asserted the essential self-justification of all great historic events. It was humanitarian and libertarian, thus in itself opposed to the absolutism of the age. Contrary to the prevailing opinion, Herder's theory of history fully accepted revolutions as part of the historical process. All these factors combined to make Herder one of the vast majority of German intellectuals who hailed the French Revolution with enthusiasm.

Herder's sense of history enabled him to view the Revolution with a historical perspective uncommon among his contemporaries, and to divorce the lasting significance of the French Revolution from the historical accidents of its terror and violence. Thus, though himself disappointed with the excesses of the Revolution, he maintained his sympathies with its ideals even after the majority of German intellectuals had been alienated from it.

The French Revolution influenced Herder's thought in many ways, but did not cause him to modify the basic premises of his theory of history. He now stressed the desirability of peaceful evolution in the affairs of men. Abandoning his Rousseau-inspired conviction of the eventual decline of all civilizations, he now evolved the idea of national rejuvenation by means of social change. Under the impact of the Revolution he formulated his concept of Nemesis, symbol of historical retaliation for mankind's past mistakes.

The struggle between Revolution and counter-revolution made Herder aware of the realities of political life. His ideal of Humanität now stressed the necessity of solidarity among men. His nationalism changed from its predominantly cultural orientation, and Herder now advocated the political as well as cultural unification of Germany. Anti-Prussion though he was, he proposed a close alliance between Prussia and Austria which anticipated the later großdeutsch movement. He even conceived the idea of a central power in Europe which approximated the Mitteleuropa concept of later years.

In the 1770's Herder had been among the inspirers of the anti-rationalist revolt of Storm and Stress in Germany. This makes his decided return to the Enlightenment perhaps the most outstanding aspect of his post-Revolutionary writings. Like most European thinkers he believed that the Enlightenment had paved the way for the French Revolution. But the resulting partisan fanaticism impressed him with the dangers of irrationalism, not of rationalism. He therefore saw in the ultimate victory of reason the only cure for the irrationalities of the age. With this attitude he stood almost alone in Germany against the dominant European current of thought which, in dual reaction against Revolution and Enlightenment, turned to Romanticism.

This new rationalism, and not a reconciliation with enlightened despotism, explains Herder's new appreciation of Frederick the Great's philosophy. This is shown by the man whom he upheld as the model of enlightened humanitarianism: Benjamin Franklin, rationalist representative of a middle-class republic.

Herder's unwavering liberalism pointed to the future. It lived on, in Western thought, through the work of Quinet, Michelet, and their disciple, Mazzini. Thus Herder became a link in the chain which binds nineteenth century liberalism to the Enlightenment.

Microfilm copy of complete manuscript of 455 pages, $5.69. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-420.

THE STRUGGLE FOR POWER BETWEEN GERMANS AND CZECHS, 1907-1911

(Publication No. 4676)

Suzanne Granitsch Konirsh, Ph.D.
Stanford University, 1953

The study concerned the relations between Czechs and Germans in the Austro-Hungarian monarchy after elections by universal suffrage had replaced the old curia system in 1907. The sponsors of the election reform, mainly Emperor Francis Joseph and the Social Democrats, had expected that the need of the common people for social and economic improvements would push the national disputes into the background. These expectations seemed realized when the first elections by universal suffrage administered a severe defeat to all nationalists.

The Czech nationalist deputies, however, continued to stress the national issues in the new Reichsrat. Their demands were by no means identical with the claims to self-government raised in 1848. In 1907 most Germans would have consented to a federal reorganization in Austria in return for national autonomy for the German minorities in Bohemia and Moravia. The Czechs, on the other hand, would have accepted such a solution in 1870 but then the Germans, seemingly secure in their domination of Austria, rejected it. Within twenty years the situation had reversed itself and after 1890 the Czechs consistently rejected similar proposals by the Germans. The industrial revolution had sent many Czech workers into German territories and the broadening of suffrage gave political domination in Bohemia and Moravia to the Czechs. This expansion opened to the Czechs prospects of still greater political power, and many Czechs dreamed of a dominant share in the central bureaucracy and even of capturing of the apparatus of the state by Austria's Slav majority. The original issues of individual liberty and equality had given way to a struggle for power. It expressed itself in many bitterly fought battles: the use of the Czech language by government officials, the relative number of Czech and German public servants, the division of revenue and taxes, and the establishment of Czech minority schools. In the field of foreign affairs the Czechs demanded the replacement of the German alliance with an alliance with Russia.

These issues dominated the debates in Reichsrat and diets and the negotiations conducted by the government; federalism, representative and responsible government were rarely demanded and never became a serious issue. Some of the pending issues had been settled for Moravia by the compromise of 1905; it failed, however, to divide the budget and the positions in the imperial civil service and thus left much ground for further nationalist agitation. In Bohemia, the Germans obstructed the diet after 1908 because the Czech majority consistently rejected their demands for some sort of self-government for the German territories. Only Silesia remained comparatively free of the national struggle but there the Slav majority was split between Czechs and Poles who usually were at odds with each other.

In the Vienna Reichsrat neither the Czechs nor the German nationalists were able to rally a majority behind their national program; they paralyzed parliament by filibuster and physical obstruction whenever it suited their strategy in the battle for power, and rarely permitted serious debate of any issue. The government searched for compromise by persuasion and concessions, by negotiations and by legislation. Its negotiations often seemed close to success but both national groups in the end rejected the last crucial concession. Efforts to effect a solution by legislation proved equally futile; the Czechs obstructed all discussions of the government bills. The moderates on both sides privately admitted the need for national peace but feared the reprisals of their co-national radicals who were exploiting the misery of the masses for nationalistic purposes. Thus, the nationalists destroyed the reputation of parliament and an all persuasive reluctance to shoulder responsibility paralyzed Austria. When the country entered the war in 1914 the government hesitated to call a Reichsrat session for fear of the national controversies it would provide. Nationalist egotism had made government by bureaucracy not only possible but inevitable.

Microfilm copy of complete manuscript of 611 pages, $7.64. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-421.

THE AMERICAN FEDERATION OF LABOR AND AMERICAN FOREIGN POLICY, 1886-1912

(Publication No. 4681)

Delber Lee McKee, Ph.D.
Stanford University, 1953

This study is a historical survey of the attitudes of the American Federation of Labor toward American foreign policy during the years 1886 to 1912, years when the Federation was by far the largest representative of organized labor in America. In the period covered, the dissertation views the importance of the A.F. of L. with regard to American foreign policy as mainly deriving from its character as a new and powerful functional group whose interests theoretically superseded national boundaries, and as a body of American citizens whose attitudes, by virtue of that fact, played some part in the molding of national policy.

The study finds erroneous the common belief that immigration was the only international interest of the A.F. of L. Rather, it discovers that the Federation was developing a foreign policy outlook of considerable breadth and clarity, and that in it were many of the principles which were later associated with Woodrow Wilson. More specifically, the impact of the Federation upon foreign policy appears to have been noteworthy in three respects: as a brake upon imperialism, as a dynamic behind internationalism, and as a force that was undermining the national policy of peace, amity and commerce with the Far East.

The survey follows a roughly chronological-topical arrangement. During the first ten years of existence, the Federation seemed to be largely indifferent to issues affecting foreign policy, but in 1887 the Federation did endorse the principle of international arbitration. Its interest in foreign nations was often based upon the reactions of a particular country toward the labor movement.

The Cuban insurrection brought enthusiastic support for the revolutionists, and in 1895 the Federation's president called upon the government of the United States to recognize the belligerent status of the Cubans. As war approached, the A.F. of L.'s ardor for the Cuban cause cooled slightly. It became disillusioned when the United States annexed Hawaii, and within the next few months Samuel Gompers began criticizing the policy of expansion with increasing bitterness. When the new areas were formally annexed, the A.F. of L. gave up its opposition but insisted upon a paternalistic treatment of the new acquisitions. It had an important molding influence upon the character and destinies of the island possessions.

The relations of the Federation with the administration of Theodore Roosevelt were generally good. The A.F. of L. acquiesced in the Caribbean policy of Roosevelt, though a few individuals criticized the taking of the Panama Canal area. In regard to the Far East, however, it gained the President's support for a policy excluding Chinese immigrants and was mainly responsible for shaping the character of the exclusion legislation of 1902 and 1904. On the question of Japanese exclusion, it was less strongly united.

Despite the effect of some of its activities in Far Eastern affairs, the Federation maintained that at all times and under all circumstances, it stood for peace. Its leaders helped to build up enthusiasm for the calling of the First Hague Conference, and they threw their support more fully behind the calling of the second one.

During the Taft administration, the Federation withheld criticism from Taft's "Dollar Diplomacy," but it also withheld support from his arbitration treaties. The Canadian reciprocity treaty was favored unofficially. Passive at first over the Mexican Revolution, the A.F. of L. demanded a "Hands Off" policy as the Administration moved slowly toward intervention.

Sources for the study were mainly the reports, resolutions, and debates at the annual conventions of the A.F. of L., also the minutes of the executive council, lobbying reports, and editorials in the American Federationist.

Microfilm copy of complete manuscript of 291 pages, $3.64. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-422.

EARLY MANUFACTURING IN LANCASTER COUNTY, PENNSYLVANIA, 1710-1840

(Publication No. 4959)

Carlton O. Wittlinger, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ARTHUR C. BINING

This study traces the development of manufacturing in Lancaster County through a period of 130 years after the first settlers entered the area. During this interval the county progressed from a small frontier settlement to an advanced agricultural and industrial community with a population of more than 84,000. Thus the study involves an intensive analysis of the changes which occurred within a small, selected, geographical area as the simple home industries of a pioneer economy grew into a complex manufacturing system designed to serve the interests of large numbers of people.

Throughout the paper the focus of attention is upon manufacturing. However, some consideration has been given to other economic aspects such as mining, transportation, finance, and agriculture. The last-named has been selected for somewhat detailed analysis, as farming rather than manufacturing was the chief economic interest of the area throughout the entire period studied. This is reflected in the fact that before the close of the eighteenth century the local farmers, under the leadership of the Pennsylvania-Germans, capitalized upon fertile soil and excellent climate to earn for the county the designation, "Garden of Pennsylvania," a title retained with variations until the present day.

Among the many factors which guided the development of early manufacturing in Lancaster County, the agricultural environment was of the utmost importance. Grain milling and distilling became two of the leading industries and supplied large quantities of flour and whiskey for export. Industries such as textile manufactures, oil milling, and tanning sprang up to utilize farm produce other than grain. Another group of enterprises including blacksmithing, coppersmithing, cooperage, wagonmaking, and leatherworking, was greatly stimulated by the market created by the farms and grain-consuming manufactures. Thus, directly or indirectly, the agricultural environment profoundly influenced most of the industries of the county. Several other important factors were at work, however. The presence of valuable natural resources including timber, clay deposits, and iron ore, encouraged the growth of a group of indigenous manufactures which did not consume farm produce. Of this number, the charcoal forges and furnaces were of outstanding importance. The inland location of the county at the crossroads of the major routes between Philadelphia and the West encouraged both trade and manufacturing. Internal improvements such as the Lancaster and Philadelphia Turnpike, the Conestoga Slack-water Navigation, and the Columbia and Philadelphia Railroad facilitated marketing. The demand for railroad castings and locomotives, created by the last-named improvement in the 1830's, greatly stimulated cupola foundry and machine shop industries, thus paving the way for a revolution in secondary iron manufactures. Excellent mill sites abounded on the numerous streams and made possible the use of power machinery which was introduced at an early date and eventually applied in many industries. Water was the principal prime mover throughout the period studied, although forward looking industrialists began to turn to steam in the 1830's. Beginning early in the eighteenth century, selective immigration contributed many skilled German craftsmen to capitalize upon the advantages of the natural environment.

With the exception of the ironworks, and Henry William Stiegel's glass houses at Manheim, the eighteenth century manufacturing enterprises of the county were on a small scale. The factory movement made much progress in the early nineteenth century, however, and by 1840 examples of the small factory were to be found in many industries. Manufactures were financed chiefly by local capital, and the individual enterprise and partnership were the prevailing forms of business organization throughout the period under consideration.

The study divides the various manufactures into categories within which the treatment is chronological. Extensive use is made of newspaper and assessment list sources.

Microfilm copy of complete manuscript of 236 pages, $2.95. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-423.

LANGUAGE AND LITERATURE, GENERAL

THEORY OF FANCY AND IMAGINATION IN ENGLISH THOUGHT FROM HOBBES TO COLERIDGE

(Publication No. 4714)

Augustus Edwin Anderson, Ph.D.
Vanderbilt University, 1953

This study undertakes to present as comprehensive a survey of the theories of fancy and imagination within the period chosen as present resources permit. Since it closes with the views of Wordsworth and Coleridge, all that is presented constitutes a context within which these views are at last elucidated.

Any theory of fancy or imagination has as its polar limits a regard for sense experience on the one hand and for aesthetic response on the other. Thus this study proceeds generally from a review of psychological theory to aesthetic considerations. The first chapter, beginning with a review of Hobbes's empiricism and the idealism of Cudworth and the Cambridge Platonists, traces the development of these two systems to Coleridge's day and identifies their respective contributions to an understanding of the nature and role of the senses. The second comprises their characteristic views on the nature of ideas, the principles by which ideas are related, and the nature and growth of idea-complexes, together with the implications in these for aesthetic speculation. The third chapter, seeking to provide the general intellectual context for the subsequent descriptions of fancy and imagination, reviews the conceptions held of the nature and function of the other mental powers or faculties — memory, judgment, understanding, reason, and will. It shows how the more mechanistic aspects of empirical interpretation lent themselves readily to formulation in terms of faculty psychology, according to which the highest powers of the mind were limited to a mere reconstruction of sense data. The idealists, on the contrary, held that ultimate truth was comprehended through intuition only. But together with these a growing emphasis which made feeling the ultimate measure of truth had important implications for an ultimate theory of imagination. The fourth chapter has to do with fancy and imagination only, and here the theories are classified after the functions attributed to these powers as (1) representative or reproductive, (2) productive or compositional, (3) elaborative or illustrative, and (4) creative. Hobbes noted all four functions. Locke stressed the compositional, and, after him, Berkeley, Hume, Reid, and others. Dryden and Pope, among others, stressed the illustrative. After Hobbes, Dennis emphasized the creative role, and we find this elaborated and refined in the views of Addison, Hughes, Welsted, Akenside, Collins, Hartley, Harris, Thos. Warton, Kames, Reynolds, Duff, Burnett, Blake, Gerard, and Beattie. Throughout this development significant advances were made by those theorists who at once exploited the empiricist and idealistic traditions. At last, in Wordsworth and Coleridge, this disposition bore its finest fruits.

The study seeks to show

1. That, in the period studied, the diversity and range of speculation concerning fancy and imagination are greater than any previous study has shown them to be.
2. That certain writers generally disregarded in previous studies have made significant contributions to the development of the theories.
3. That, correspondingly, the quality and extent of the contributions of certain other better-known theorists are somewhat corrected when viewed in the light of the total development.
4. That, from this more complete reconstruction of the speculative developments of these times, there emerges an ampler and clearer impression of the range and quality of English idealistic philosophy and its relation to developing theories.
5. That the appropriation of the two great philosophical traditions and their felicitous exploitation in a single critical system is also characteristic of the period and resulted in some of the most significant developments.
6. That Coleridge's own views are the manifest and reasonable issue of preceding native speculation, that they derive from — and were nurtured in and sustained by — points of view discoverable in Coleridge's own seventeenth and eighteenth century background.

Microfilm copy of complete manuscript of 559 pages, $6.99. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-424.

A CRITICAL EDITION OF A KNACK TO KNOW A KNAVE

(Publication No. 4896)

Paul Esmond Bennett, Ph.D.
University of Pennsylvania, 1952

The dissertation consists of an introduction to the text, the text proper, and annotations.

The introduction to the text discusses the following matters:

1. Date of composition. The play is shown to have been written, in all likelihood, not long before its initial performance at the Rose on 10 June 1592.
2. Stage history. So far as we know, the play was presented seven times, first during the season of 1592, which was cut short, and again during the season of 1593.
3. Literary affinities. The play is linked to the morality on the one hand and to the pseudo-historical romance on the other. Its only close relative is Nobody and Somebody.
4. Criticism. The play is admittedly of more

historical than literary importance, though the corrupt state of the quarto-text makes it difficult to judge. The play is of some significance as the first dramatic treatment of the Edgar-Alfrida story, as the first treatment to give the story a happy ending, and as a source of Massinger's Great Duke of Florence.

5. Social background of the morality half of the play. The attitude of the playwright toward the villains of the piece is compared with that of a number of other Elizabethan writers toward similar villains and is seen to be thoroughly conventional.

6. Sources of the romantic half of the play. Stemming from William of Malmesbury, the Edgar-Alfrida story appears in a number of Elizabethan histories and chronicles. It is not possible to find one specific source, since the playwright altered his material.

7. Origin of the text. The corrupt nature of the text, the badness of the blank verse, and the obscurity of the crucial romantic scene seem to indicate that the quarto text was memorially reconstructed by some of the actors who had taken part in performances of the play in 1592 and 1593.

8. Authorship. The original version of the play is tentatively assigned to Robert Greene on the basis of internal evidence such as plagiarization of his Carde of Fancie, vocabulary, and general resemblances between the play and his known work. Attention is paid to attributions of the play to George Peele and Thomas Nashe.

9. Bibliographical descriptions. The four extant copies of the quarto differ from one another in several unimportant details.

10. Previous editions. The editions of John Payne Collier and W. Carew Hazlitt are shown to be unsatisfactory by modern standards.

The text presented is intended to be an accurate old-spelling line-for-line critical and diplomatic edition. It is based on the Farmer facsimile collated with microfilms of the other extant copies of the quarto and with the editions of Collier and Hazlitt. The most significant editorial change involves the reconciliation scene between Edgar and Ethenwald. The present edition clears up the obscurity of this scene by emending the stage direction which introduces this scene. This emendation is defended in the annotations, which also explain other obscurities in the text.

Microfilm copy of complete manuscript of 257 pages, $3.21. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-425

THE MIND OF EDWARD EVERETT

(Publication No. 4690)

William Kenneth Christian, Ph.D.
Michigan State College, 1952

The purpose of this study was to seek out and evaluate the ideas of Edward Everett on history, education, American literature, economics, and slavery.

Chapter One, "The Careers of Edward Everett," provides a biographical sketch, showing his careers as minister, teacher, editor, orator, politician, governor, ambassador, college president, Secretary of State, and writer.

Chapter Two, "History and Its Lessons," presents his views concerning American history. The Pilgrims created a refuge from Europe's religious and political tyrannies. The American Revolution was the "most momentous event" in history, and the Constitution, which "completed the great revolutionary movement," is the safe-guard of liberty. All history proved the greatness of the American heritage. In the drama of liberty the star-hero was George Washington.

Chapter Three, "Literature in America," discusses Everett's meagre literary comments. As editor of the North American Review, he vigorously defended American literature against British ridicule. Everett did not understand Emerson or anything connected with the transcendental movement. He had praise for Bryant, Longfellow, Whittier, Irving, and Cooper; he was aghast at Whitman. Everett's interest in his own oratory and political ambitions contributed to his lack of appreciation for contemporary literature.

Chapter Four, "The Champion of Education," concerns the ideas Everett expressed in support of education. He advocated teacher training, general education, and practical science. The popularization of knowledge aids the development of real learning. The press, free government and Christianity are three great modern instruments for the extension of education and civilization.

Chapter Five, "The Voice of Wall Street," outlines his economic ideas. He held the conservative Whig view that property rights were the basis of civilization. In America everyone has an equal chance for economic advancement. The Declaration of Independence was the cause of the expansion and the economic development of the country. Everett argued for protective tariffs, trying to show that all the people would benefit from them. As governor of Massachusetts, he urged complete abolition of imprisonment for debt and wanted legal restrictions on banks.

Chapter Six, "Social Change, Slavery, and the Union," deals with Everett's views of social change and his attitude toward slavery. He believed optimistically that human progress was assured. He held the philosophic view that social welfare required the interaction and balance between conservative and progressive elements. He considered himself a conservative. Everett consistently offered the sentiment of Union as the antidote for the agitation over slavery. The true patriot worked "to merge in one comprehensive feeling all discordant sectional preferences." His position was a nebulous idealism and he blindly maintained it until Confederate guns fired on Fort Sumter. Then he made his decision to support Lincoln and the Union completely and actively.

Chapter Seven, "Wasted Genius - An Evaluation,"

presents an explanation of Everett's failure to make a lasting mark in American history. As a man, he was a complex of vanity, dignity, extreme self-assurance, and boundless energy. His public utterance was overly polished and freighted with scholarship. Political ambition and the desire to be president dominated his entire life. But Everett lacked the courage to face the slavery issue and he did not possess the fighting, tough, resilient mind essential for political success.

Microfilm copy of complete manuscript of 482 pages, $6.03. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-426.

THE PAGEANT DRAMA AND AMERICAN PAGEANTRY

(Publication No. 4919)

Claude E. Dierolf, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: EDGAR L. POTTS

The Pageant Drama and American Pageantry presents an historical survey of the pageant movement in America from its tenuous beginnings in 1905 down to 1952. The dissertation indicates that the movement became ubiquitous throughout the United States after receiving its initial impetus from the English pageant-master Louis N. Parker, who presented the first of his highly successful open-air, community historical pageants at Sherborne, England, in 1905. However, pageantry became popular in America not only because of the success of the British models but also because the first two decades of the twentieth century witnessed an increased interest in open-air drama. In addition there was the concomitant belief that pageantry could foster patriotism, loyalty, cooperation and aesthetic awareness among the members of a community that participated in presenting a pageant.

Since the term pageant has received innumerable definitions, it is used broadly in this work to refer to dramatic spectacles presented indoors or out-of-doors that contain music, dancing, dialogue, and pantomime or parts of these and tell a story in episodic rather than in closely knit dramatic form. However, in order to make the individual analyses of pageants more meaningful, differentiation has been made among such types of pageants as processional pageants, historical pageants, masques, pageant-masques and pageant dramas.

The pageants were included with two criteria in mind. First, those pageants were chosen that were the most artistic and dramatic; these were subjected to rather extensive analysis. Secondly, others, although of less artistic and dramatic value, were included because they were representative of types of pageants given in a particular era or because they made some definite contribution to the form or technique of modern pageantry.

The creative works of two men, Percy MacKaye and Paul Green, were infinitely better than the average pageants encountered; therefore, the masques of MacKaye and the symphonic dramas of Paul Green loom large in this study. Although Green calls his symphonic dramas plays and MacKaye categorizes his large, spectacular works as masques, the term pageant is broad enough to include both of their diverse contributions. Their outdoor community dramas belong, therefore, to the history of pageantry rather than to the history of drama.

Less important pageant writers who merited more than casual mention were such authors as George Pierce Baker, Thomas Wood Stevens, William Chauncy Langdon, Constance D'Arcy Mackay, Ethel T. Rockwell, Frederic H. Koch, and Sidney Coe Howard. All of these people wrote individual pageants of value or made definite contributions to the pageant movement.

Microfilm copy of complete manuscript of 271 pages, $3.39. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-427.

SAMUEL JACKSON PRATT: NOVELIST AND POET (1747-1814)

(Publication No. 4364)

C. Ruth Wright Hayre, Ph.D.
University of Pennsylvania, 1949

Samuel Jackson Pratt (1747-1814), was one of a host of seemingly talented but mediocre scribblers who wrote at the turn of the 19th century. He was the first English novelist to introduce the theme of the American Revolution as material for fiction (Pupil of Pleasure, 1776), and the first English author to write a novel employing the event of history as the background of the story, and as a chief motivating factor of the actions and characters of the novel (Emma Corbett, 1780). With the appearance of this latter book the Revolutionary War figured conspicuously in the novel for the first time since the start of the war. Pratt was the first writer to mention George Washington, involving him in the fictional experiences of the story. The influence of this book was even greater than might at first be surmised because Pratt's Emma Corbett and many novels subsequent to his, depicting the painfulness and loathsomeness of the American War, heightened a humanitarian spirit which foreshadowed an important Romantic renascence.

This dissertation presents a study of Pratt's life and voluminous works. Sources have been as follows: First, what Pratt wrote about himself in his published works, and this is not nearly so full nor so accurate as one would hope. He wrote very little concerning himself. His friend, John Taylor, mentioned that he had written a copious account of his life in two large volumes, of which he had made an abstract. Unfortunately, if Pratt wrote such an autobiography, it was never published, and the manuscript of it is not extant: hence much of his life must remain unknown.

His novels, especially the first one, Liberal Opinions, have been cited as being autobiographical, but although undoubtedly much of the stuff that went to make Pratt's own life has been put to fictional use in the novels, we cannot use them as authoritative biographical sources. His Gleanings, a six volume travelogue describing his journeys through France, Westphalia, Holland, and the various counties of England and Wales during the last decade of the century, gives more insight into his personal life than anything else from his pen. A lengthy biographical memoir and critique of his works appeared in several consecutive issues of the Monthly Mirror for 1803, ostensibly written by a lady friend of his whose name he refused to divulge, but much of the material contained therein is not authentic.

Pratt was an avid letter-writer, and some of his correspondence in manuscript form is available. Especially valuable are the fifteen letters (unpublished) written to Benjamin Franklin, the sixteen letters to Mrs. Elizabeth Montagu, and several letters to his publishers, and to friends, Dr. Warner, Dr. Lettsom, and others. The letters to Franklin were written between November 14, 1777, and May 12, 1778, when Pratt was in Paris using the name Courtney Melmoth. He apparently cultivated Franklin's acquaintance with the view of obtaining a paying position with the American commission. He borrowed frequent sums from Dr. Franklin and there is no evidence that these were ever repaid.

A second major source of information about this author has been what others have written about him; this represents an extensive array of material, published and unpublished, covering a century and a half. Pratt may have been "minor" in importance, and he is a forgotten writer today, but in his time he was not neglected. Many of his contempories, including Anna Seward, Mrs. Sarah Siddons, the actress, Byron, and Lamb, were addicted to the epistolary craze, and in voluminous letters made mention — sometimes at length — of their friend "Pratty." Nor was Pratt neglected by the press. In the newspapers, reviews, magazines, and journals of the day, there are frequent allusions to events of his life, as well as critiques of his works. Much of the material is inaccurate and distorted. Literary historians and biographers have furnished data on Pratt, although they, too, sometimes showed bias and carelessness.

My third source has been documentary materials, of which there were few. Parish records of his birth, his parents' deaths and burials exist, but none confirming Pratt's marriage, children's births, or his death. There are no genealogies on either side of his family, rather surprisingly, as they belonged to the upper middle class. A canon of his works can be fairly well established from contemporary catalogs and booklists.

On the whole it is not too difficult to reconstruct and evaluate Pratt's life and character from the materials we have at hand. He grew up from a lonely, spoiled, sensitive child to a young man with a love for learning and the classics, but with a restless, uneasy nature, and no definite goal in life. He was at various times preacher, lecturer, actor, public reader, book-seller, novelist, playwright, poet, and critic. He was a great lover of society in general, and especially championed in his writings the less fortunate as, the African slave, the debt-ridden farmer, the impoverished factory hand, and others.

Microfilm copy of complete manuscript of 204 pages, $2.55. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-428.

THE INFLUENCE OF SIXTEENTH AND SEVENTEENTH CENTURY SPANISH MYSTICS AND ASCETICS ON SOME METAPHYSICAL WRITERS

(Publication No. 4680)

Eleanor M. McCann, Ph.D.
Stanford University, 1953

This dissertation investigates parallels of thought and content between six English metaphysical writers — Robert Southwell, John Donne, George Herbert, Richard Crashaw, Joseph Beaumont, and Henry Vaughan — and sixteenth and seventeenth century Spanish mystics and ascetics, notably Juan de Valdés, Ignacio de Loyola, Luis de Granada, Diego de Estella, Santa Teresa, Juan de la Cruz, Luis de León, and Nieremberg. At times these parallels represent indubitable borrowings.

The writings of Spanish mystics reveal several outstanding characteristics, including the blending of opposites such as death and life, eroticism based on the Song of Songs, stern asceticism, tolerance, and reliance on introspection. Jesuit teachers in the many Catholic-sponsored universities in Europe imparted these strains of mysticism to English Catholics who studied abroad, and refugees from the Inquisition brought Spanish books and ideas into English schools. Southwell translated Loyola and Estella; Herbert, Valdés; and Vaughan, Nieremberg. Crashaw wrote at length about Teresa, and Beaumont wrote Psyche, a tedious compendium of his scholarship in Spanish mysticism.

An outstanding area of Spanish influence is the use of oxymora, or blending of opposites. Donne, Crashaw, and Vaughan used paradoxical terms involving blind sight, or obfuscation by heavenly light, as described by Juan de la Cruz and Luis de León. Southwell and Crashaw used the oxymora of fiery water and cooling flame associated with the Mary Magdalen story. Crashaw and Beaumont used Teresa's expressions about dying life and the sweet wounds of love.

Erotic itimacy and violence are common among the Spanish and English writers. Juan de la Cruz's concept of cauterization of the heart appears in a Donne sonnet. Nieremberg's expression, silex scintillans, suggesting the salutary effect of divine friction against a stony heart, becomes the title for a volume of Vaughan's poetry. Borrowing from Luis de León, Crashaw suggests that Christ is both pastor and pasture to his flock.

Passages on death in Donne's sermons, which have been considered peculiar to him, are strikingly similar to Granada's popular oratory on the subject of graveyard doom and damnation. In "The Ecstasy" Donne may have drawn from several chapters in Teresa's Life in which she describes the contorted body, the struggling soul, and the desire to return to normalcy. Her account of the "heavenly language" used by the soul suggests, not only Donne's poem, but Crashaw's statement that Teresa speaks "heaven" rather than "Spanish."

In addition, Donne and other English writers may have drawn from Spanish sources a notion that viae diversae led to truth. This concept led to religious tolerance. The image of Truth on a hill in Donne's "Third Satire" is similar to passages in Luis de León and Granada. Herbert pleaded for tolerance toward Valdés, a heterodox mystic, and Crashaw and Cowley defended Teresa as one who belonged to an international brotherhood of souls.

Donne, Crashaw, and Vaughan show evidence of being influenced by Loyolan methods of meditation, as they dwell on sensory details surrounding Christ's birth and death. Donne and Herbert follow Loyola's advice to speak familiarly to Christ. Details of the circumcision, the bloody sweat, and gaping wounds, which were congenial to Spanish taste, appear in the writings of Southwell, Donne, and Crashaw.

Microfilm copy of complete manuscript of 229 pages, $2.86. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-429.

ASPECTS OF SHAKESPEAREAN CRITICISM, 1914-1950: A COMMENTARY CENTERED ON BRITISH AND AMERICAN CRITICISM OF HAMLET

(Publication No. 4877)

Francis G. Schoff, Ph.D.
University of Minnesota, 1952

A survey of almost four hundred books and articles relating to Hamlet and his play reveals a stream of characterizations which contradict each other completely or in great part, but most of which agree in making out of Shakespeare's young hero a figure which in one way or another is psychologically warped or morally tainted. The psycho-analysts have attributed to him most of the mental ailments familiar in the field, from the Oedipus Complex to dementia praecox and schizophrenia. G. Wilson Knight finds him a titanic ambassador of death and cynicism; a blighting influence on his associates and Denmark. L. C. Knights, on the other hand, finds him no superman, but a youth trying to "escape from the complexities of adult living"; while Howard Mumford Jones sees him as an ivory-tower incompetent. For Sir Edmund Chambers, Hamlet cannot act rationally because he thinks too much; but for Murray W. Bunday he is driven by excess of passion. By other critics Hamlet has been called a hypochondriac, a man incapable of emotion, a sufferer from mental paralysis, a man delighting in his "enfranchised and emergent mind," and an actor glorying in his part.

The concatenation of critical contradictions, which eventually becomes absurd, quite clearly results from assuming (1) that Hamlet was conceived as a rounded, psychologically complete figure, and (2) that the element of delay in the play is central in appraising his character. These assumptions lead to probings of Hamlet's mind on a highly subjective basis, and to disregard of the warnings of Elmer Edgar Stoll that Shakespeare was a dramatist, not a psychologist; a poet, not a seer.

A few critics — Hazelton Spencer, W. W. Lawrence, and Hardin Craig are representative among the historical critics; A. J. A. Waldock, W. Macneile Dixon, Agnes Mure Mackenzie, and C. S. Lewis among other groupings — hold like Stoll to the romantic hero of Shakespeare's play, and seek to dissociate their own minds from Shakespeare's. As a result, though with the exception of Stoll they do not always separate carefully the conventions of literature and the stage from the complexity of real life, they help in various ways to enlarge and deepen the student's understanding of the play and its values. For the most part, however, one finds an almost unrelieved subjectivity of approach dominant. Everywhere one turns he finds critics who are seeing not Shakespeare, but themselves dressed in Shakespeare's clothes. The situation has been especially regrettable among the new critics, who have in general rejected the advances in knowledge made by the historical critics and have driven blindly along nineteenth century ruts, with variations on old themes made possible by amateurish utilization of methods and information taken over from the fields of psychoanalysis and anthropology. As a result, a promising new approach has so far been largely wasted. We have only suggestions for future development from J. W. Draper, Harley Granville-Barker, and Stoll, with more narrowly restricted ones from Caroline F. E. Spurgeon and a few others, to show what could be done if the approach through prosody and image were to be used with those careful qualifications made possible through the knowledge elsewhere available.

Microfilm copy of complete manuscript of 504 pages, $6.30. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-430.

SIR RICHARD FANSHAWE: AN ACCOUNT OF HIS LIFE AND WRITINGS

(Publication No. 4898)

William Eugene Simeone, Ph.D.
University of Pennsylvania, 1950

SUPERVISOR: ARTHUR H. SCOUTEN

The life and literary work of Sir Richard Fanshawe is interesting for a number of reasons. In his life time, he won the respect of his contemporaries as a talented linguist, a courtier, a soldier, a diplomat, and as a man of letters. In this dissertation, an

attempt is made to tell the story of Fanshawe's life, and also to survey and assess his literary work. The biographical portion of the thesis is essentially a chronicle of Fanshawe's steadfast devotion to the Royalist cause of Charles I and Charles II. Following accounts of his family and education, there are chapters devoted to Fanshawe's services to the Crown, beginning with his first diplomatic assignment in Madrid as secretary to the ambassador, Sir Walter Aston, and ending with his last assignment as ambassador to Spain.

As a man of letters, Richard Fanshawe's activities were limited by a paucity of time and inspiration. He has written a handful of original poems and a number of translations of considerable merit. In his poetry, Fanshawe combines some of the qualities of his Elizabethan predecessors with some of his neo-classical contemporaries; in this sense, his poetry can be called transitional. As a translator, Fanshawe's work is significant, not only as a good example of seventeenth century paraphrase, but also because it is often written in a lively and colorful style which lifts it above many of the common-place translations of the age.

In addition to the text, there are three appendices. The first includes three letters, of biographical and literary interest, transcribed from originals in Fanshawe's holograph. The second appendix includes a number of his unpublished original poems, transcribed from manuscripts preserved in the British Museum. The third contains unpublished translations of some of the epigrams of Martial, and of the metrical portions of the Consolation of Philosophy of Boethius, transcribed from manuscripts preserved in the British Museum.

Microfilm copy of complete manuscript of 307 pages, $3.84. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-431.

LANGUAGE AND LITERATURE, MODERN

CHARLES GILDON'S A NEW REHEARSAL, OR BAYS THE YOUNGER: EDITED WITH AN INTRODUCTION AND NOTES

(Publication No. 4911)

George L. Anderson, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ARTHUR H. SCOUTEN

The New Rehearsal, a satirical dialogue by Charles Gildon published in 1714, is of historical and critical significance because it is important evidence in the quarrel between Addison and Pope and the breaking up of literary society at the end of the reign of Queen Anne into Whig and Tory camps, and in the recognition of a new kind of Neo-Classicism represented by the works of Rowe and Pope.

Pope believed — or Spence's Anecdotes reports him as believing — that Addison paid Gildon to abuse him and his family and said that his "Atticus" satire intimidated Addison into silence during the remaining years of his life. The New Rehearsal is proposed as the offending work by Norman Ault (New Light on Pope) and has been considered by George Sherburn (The Early Career of Alexander Pope) and others. By reconstructing the relations, social and political, of Addison, Steele, Pope, Swift, Defoe and others, in a day-by-day chronology, it is possible to determine the atmosphere in which the New Rehearsal was written and published. The work was published, newspaper evidence shows, on April 3 or 4. It is very unlikely that (1) Addison paid Gildon to write it, (2) that Addison encouraged it, or (3) that Pope and Addison had cause to quarrel in March, 1714. The work is an independent attack, Whig in flavor and certainly friendly to Addison, but it deprecates the coffee house group at Button's founded by Addison, urges Lord Halifax — not Addison — to become Whig patron of letters, and attacks with great energy Rowe, an outspoken Whig in great favor with the party. Nor is the New Rehearsal the kind of satirical attack on Pope that came from the Whig group at Button's a few months later. This would rule out the work as the cause of Pope's quarrel with Addison and of the "Atticus" lines.

Critically, the New Rehearsal recognizes in Rowe's plays (especially in Jane Shore) a new tragedy concept with emphasis on pathos and elaborate descriptions. This kind of tragedy, Gildon believes, is further away from the rigid Aristotelian Neo-Classical principles for which Gildon had long fought and also further away from these principles than the tragedies of the age of Dryden and Otway. In Pope's Rape of the Lock, Gildon sees a clever and elaborate toying with Neo-Classical ideas. The poem as he sees it is a pastiche of Neo-Classical bric-a-brac, further in both spirit and form from the ideal than the more rugged satire of the age of Dryden. Modern critics see Pope's technique as Gildon sees it, though Gildon regards it merely as a perverting of the rules. Gildon was the first to recognize this tendency in Pope's Rape of the Lock.

The text of the 1715 edition (entitled Remarks on Mr. Rowe's Tragedy of the Lady Jane Gray), which contains additional prefatory material, has been edited with notes and an introduction which contains a study of Gildon's life, his career, his criticism, the relations between literature and politics in the age, and the criticism of the New Rehearsal.

Microfilm copy of complete manuscript of 434 pages, $5.43. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-432.

HERMAN HEIJERMANS AND HIS DRAMAS

(Publication No. 4902)

Seymour Lawrence Flaxman, Ph.D.
Columbia University, 1950

At the end of the nineteenth century, at a time when the "free-theatre" movement was revitalizing the European stage, Herman Heijermans became the foremost dramatist in Holland. Born on December 3, 1864 in Rotterdam, Heijermans was at first destined for a career in business, but his early hopes of success died as financial failure brought disgrace and the threat of bankruptcy. He had always wanted to be a writer, and when his first story, A Jew's Trick?, was published in De Gids, he saw a chance to leave his native city for the metropolitan cultural center of Amsterdam. Here he found a livelihood writing for De Telegraaf, and in his column in this newspaper was born his famous series of sketches of Amsterdam life later known as Falklandjes. Here too he met Marie Peers, whom he married in 1898. It was in Amsterdam that he came in contact with the growing workers movement and joined the Socialist Party. During this period he founded his own magazine, De Jonge Gids.

The reception of Dora Kremer, his first play to reach the stage, was a great disappointment to him. But with Ahasversus and Ghetto, he displayed an original talent and established himself in the Dutch theatre. Heijermans was determined to further the cause of Socialism through the drama, and this aim often led the critics to accuse him of tendenz. He refused to consider himself as a political propagandist, and certainly such plays as Op Hoop van Zegen (The Good Hope), Ora et Labora (Pray and Work), Bloeimaand (Maytime), and Glück auf! (Good Luck!) show the hand of the born dramatist.

Heijermans' pantheism and his love of the child, moreover, must be considered along with his socialism as forces which have expressed themselves in his work. Such plays as Allerzielen (All Souls), De Schoone Slaapster (Sleeping Beauty), and Eva Bonheur give his views of God and the cosmos. His interest in the child appears not only in these plays, but also in the imaginative fantasy of Uitkomst (The Way Out). It is Heijermans' willingness to soar on the wings of fancy, as in Dageraad (Dawn) and De Wijze Kater (The Wise Tomcat), which is the most prominent trait setting him off from the Naturalist school. Nor was his talent confined to the proletarian drama. Het Zevende Gebod (The Seventh Commandment), Schakels (Links), and De Opgaande Zon (The Rising Sun) show Heijermans' skill and craftsmanship in the creation of middle-class drama.

Although traces of Ibsen's and Hauptmann's influence may be found here and there in his work, Heijermans remained an original and independent craftsman. His sketches and novels alone have gained him a reputation, but his plays have made him Holland's greatest dramatist and brought him fame on stages all over the world.

Microfilm copy of complete manuscript of 344 pages, $4.30. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-433.

FRENCH SYMBOLISM AND MODERN BRITISH POETRY: WITH YEATS, ELIOT, AND EDITH SITWELL AS INDICES

(Publication No. 4929)

Ihab H. Hassan, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: MARK LONGAKER

The impact of the French Symbolist Movement on modern poetry has been recognized by histories and critiques of literature. Arthur Symon's The Symbolist Movement in Literature, 1899, and Edmund Wilson's Axel's Castle, 1931, indicate the growing tenor of preoccupation with this particular phase of literary developments. A comprehensive assessment of the impact has still to be made.

This study is focused on the attempt to define the nature and extent of affinities between French Symbolism and modern British poetry. William Butler Yeats, T. S. Eliot, and Edith Sitwell are selected as three major representatives of the latter period. Their achievement is examined in the light of a particular tradition which emerges from French Symbolism. Such a tradition can be termed the Symbo-metaphysical tradition; its norms are best clarified in terms of the poetry of Mallarmé, Rimbaud, Laforgue, and Corbière.

A fundamental continuity in the Symbo-metaphysical tradition, through adaptations and modifications that have led to the present language of poetry, is claimed in this thesis. No personal "influences" are considered. Emphasis is given to the sensibility which informs that tradition and to the techniques which distinguish it. Both sensibility and technique are constantly referred to the poetry itself. For the purpose of comparison, however, certain norms are abstracted and a number of defining criteria are formulated.

In consequence, it have been necessary to supplement the intrinsic approach by extrinsic considerations. The Symbo-metaphysical tradition is examined as a particular development of Romanticism. Such precursors as Gérard de Nérval, Novalis, Poe, and Baudelaire are related to Symbolism. The forces, historical, social, ideological, and esthetic, which converge on the Symbolist scene are taken into account. An effort is made to isolate from the eddies of Symbolism its perdurable contribution, a contribution which by-passes Decadence and is manifested in the Symbo-metaphysical tradition of poetry. This tradition is then intrinsically studied in terms of Imagery, Figurative Language, Diction and Syntax, Sound and Versification, and Attitudes. Its congruence and contrasts with 17th century Metaphysical poetry are noted.

The same steps are followed in evaluating the degree of permeation effected by this tradition in modern British poetry. The same criteria and norms are applied to Yeats, Eliot, and Edith Sitwell in an attempt to determine the singular contribution of each poet in the creative development of the Symbo-metaphysical tradition. Forces in the cultural configuration of the modern world are recognized.

What this thesis has assayed is the definition of a vital tradition still viable in present poetry. Its aim is to substantiate this viability by examining the techniques and sensibility that have expanded the possibilities of poetic statement, reoriented our conception of poetry, and integrated a half-century of experimentation. In fulfilling this aim it also places modern British poetry in a desirable historical perspective.

Microfilm copy of complete manuscript of 539 pages, $6.73. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-434.

WILLIAM WHITTINGHAM: A STUDY OF HIS LIFE AND WRITINGS, WITH ESPECIAL REFERENCE TO THE GENEVA NEW TESTAMENT

(Publication No. 4937)

Richard Edward Hunter, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ALLAN G. CHESTER

The purpose of this dissertation is to establish William Whittingham's position in the literary and religious history of England.

William Whittingham (c. 1524-79), after studying at Oxford (B.A., 1544; M.A., 1547), traveled in Edward VI's reign on the continent, where he met John Calvin. He returned to England about 1550, but shortly after Mary's accession he left England once more, an exile for religion at Frankfort (1554-5) and at Geneva (1555-60).

With John Knox, he led the non-Prayer Book party at Frankfort. After Knox had left, Whittingham kept his own followers there until they obtained a new home at Geneva. The first part of the famous Troubles at Frankfort, a 1575 account of the Marian liturgical struggles, has usually been attributed to Whittingham, but the attribution has little validity. None of the reasons usually advanced for Whittingham's authorship stands up under scrutiny.

At Geneva Whittingham, an officer of the English congregation, was eventually ordained. There he translated Ridley's treatise on the eucharist into Latin and Beza's treatise on predestination into English. There he married Catherine Jacquemayne (contrary to most earlier authorities, no relation to Calvin). There he contributed to and doubtless edited the metrical psalter which constitutes one section of the Order of Geneva. Most important, there he translated and annotated the Geneva New Testament (1557) and helped to produce the Geneva Bible (1560). The present study makes a careful examination of both the text and the notes of the New Testament of 1557, especially with reference to their sources and their influence. In order to accomplish the 1560 translation he remained at Geneva for almost two years after Elizabeth's accession.

Whittingham's first work as an Anglican clergyman was as chaplain under the English governor at Newhaven in 1562-3. There he was known for his diplomacy, his preaching, his care of the sick, and his reestablishment of discipline among the troops. As a reward he was made dean of Durham in July, 1563.

As dean, Whittingham displayed willingness to conform. He forewarned local authorities concerning the Northern Rebellion of 1569, helped put the rebellion down, and showed leniency toward several of the rebels. He "labored to root out the weeds of popery," negatively by defacing statues and positively by providing a rounded education for the youth under his charge.

Toward the end, Whittingham found himself in trouble on two counts. First, some of his chapter were ruffled by his leniency toward tenants of chapter lands. This quarrel came to a head in 1576. Second, after the death of Bishop Pilkington of Durham and the translation of Archbishop Grindal from York to Canterbury, Whittingham found himself opposed by Bishop Barnes and Archbishop Sandys, largely because of his efforts to preserve the freedom of Durham Cathedral from archiepiscopal jurisdiction. Tried on trumped up charges in 1578, Whittingham was acquited. Worn out by the trial and the travel occasioned thereby, he died on June 10, 1579.

About twenty-five years after his death a short account of the dean's life was written but not published. The author was almost certainly his son, Sir Timothy Whittingham.

In his own day Whittingham was important for the middle-of-the-road nature of his Calvinistic churchmanship. In literary history his chief importance is as a Bible translator, since the Geneva Bible surpassed even Tyndale's in its influence upon the Authorized Version of 1611.

Microfilm copy of complete manuscript of 315 pages, $3.94. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-435.

THE AUTHORSHIP OF SIR FERUMBRAS: ASHMOLE MS. 33 OF THE BODLEIAN LIBRARY, OXFORD

(Publication No. 4940)

Marcus Konick, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ALBERT C. BAUGH

The purpose of this study is to determine, if possible, whether the romance of Sir Ferumbras in MS. Ashmole 33 of the Bodleian Library, Oxford, is the

work of one author. The first 3410 lines, here called Ash I, are written in quatrains riming abab, familiar in many ballads, but the remainder, here called Ash II, is written in romance sixes. Such a sudden change of meter, without apparent reason, raises the question whether the romance may not be a union of two different versions.

The two parts are studied in their relation to other versions of the romance. A stemma is constructed, showing the development of the Fierabras tradition in two branches, comprising the vulgate and abbreviated versions. The former is shown to include French verse versions a, b, and d (as they are called by most scholars), the Escorial, Didot, and originals of the Fillingham and Bagnyon versions. The versions which, in the following order, increasingly abbreviated the romance are that commonly called c, the Provençal version, the Metz and Strassburg fragments, MS. 2172 of the Bibliothèque Nationale, the Latin and Irish texts, Aubert's Croniques et Conquestes de Charlemaine, the Italian, Hanover, and Egerton versions, and the Sowdone of Babylone. Because of similarities in incident, wording, name forms, and omissions, Ash I is shown to belong with the abbreviating traditions and Ash II with the vulgate.

Other differences distinguish the two parts of the romance. Ash I omits many religious references, elaborate descriptions, and irrelevant material, but adds descriptions of battle and hunting. Ash II is more faithful to the vulgate, retains lengthy prayers, religious references, and descriptions, but is not so tolerant of battle detail. Differences between the two parts in metrical usage, in the inclusion of minority forms in the dialect, and in several features of style are also pointed out.

For portions of Ash I two original drafts have been preserved and the conclusion to which this study comes is that this part of the romance is by an English poet basing his work on a French original. The handwriting of the drafts is the same as that of the finished manuscript and, except for a few corrections, the manuscript is in a single hand throughout. It is believed that the most plausible explanation of the differences which occur after line 3410 is that at this point the author began adapting another English version, or the latter part of such a version, which was available, although in a different metrical form.

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THE IRONY OF OBJECTIVITY IN THE NEW CRITICISM

(Publication No. 4700)

Frederick Beatty Rainsberry, Ph.D.
Michigan State College, 1952

A new criticism has arisen during the past twenty years which challenges traditional literary theory. Whereas the literary criticism previous to this generation had emphasized historical, biographical, or Marxist theories as a basis for aesthetic judgment, the new criticism would return the critic's attention to the poem qua work of art as the proper centre of literary interpretation.

The aim of this work is an examination of the New Critics who have employed a metaphysical tradition in their search for objectivity in poetry. The examination reveals that in their attempt to sharpen and to systematize their principles of criticism, they have ironically absorbed the defects as well as the most dynamic qualities of metaphysical idealism. The most living sources of this tradition have been Coleridge's Biographia Literaria and other philosophical essays, Hegel's Phenomenology of Mind, and Croce's Philosophy of the Spirit. To maintain the same spirit of objectivity in evaluation which the new criticism has sought in the study of poetry, an exegetical method of paralleling the critical and philosophical texts has been employed. By juxtaposition with the living tradition of idealism, the author reveals in his examination of Samuel Taylor Coleridge, John Crowe Ransom, Allen Tate, Cleanth Brooks, Kenneth Burke, and the Chicago Critics, persistent problems which the metaphysical idealist must face in his search for objectivity.

The examination of John Crowe Ransom reveals a basic irony in the search for system. The poetic object as well as the poet's creative will are lost in the self-consistency of "the world's body," Ransom's symbol of ontological unity. As he tries to reaffirm his belief in the existence of a world of real things, his account of the creative will becomes simply naturalistic and the poetic object becomes materialistic.

Samuel Taylor Coleridge vigorously asserts the priority of the poet's creative will and deserts unhappy metaphysics when he recognizes that a system of thought will absorb the existence of the creative will as well as of the poetic object.

Both Allen Tate and Cleanth Brooks show the same fear of system as did Coleridge. Instead of emphasizing Coleridge's voluntaristic theme of the poetic imperative, they try to get along without a basic metaphysical unity. They place their emphasis on the reciprocal dynamic process between the poet and the poetic object. The strength and weakness of Tate's doctrine of tension and dramatic imagination is discussed along with Brook's more linguistic analysis of wit, paradox and irony.

Kenneth Burke's "dramatism" is a device employed to eliminate the dangers of monism. It is shown how Burke tries to relate G. H. Mead's dynamic social behaviorism to the dynamic phenomenology of idealism. In the end his enthusiasm for system turns from process to categories, from social behaviorism to dialectical materialism and both the poetic self and its object are lost in the same monistic unity.

In their interpretation of Aristotle, the New Critics as idealists fail completely to comprehend the relation of The Poetics to Aristotle's metaphysical system. To illustrate the more consistent interpretation of Aristotle, the doctrines of imitation and of katharsis are restated.

The Chicago Critics as Aristotelians are examined as the contemporary opponents of idealism in the new criticism. After a full analysis of their metaphysical and aesthetic positions, their theories are found wanting. They have selected Aristotle's method without his Metaphysics as a basis for their theories and their rationalism has in the end lodged them in the same epistemological difficulties which confront the new criticism.

In conclusion, the examination shows that any strictly rational philosophical system will not give an account of poetic objectivity. The apprehension of the poem as object is ultimately intuitive and any attempt to explain its existence by rational methods will result in the loss of both the poetic creator and his poem.

Microfilm copy of complete manuscript of 315 pages, $3.94. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-437.

J. E. SPINGARN AND AMERICAN CRITICISM

(Publication No. 4952)

L. Marshall Van Deusen, Jr., Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ROBERT E. SPILLER

The literary theory of J. E. Spingarn has been variously characterized as radical, reactionary, amateurish, pedantic, relativistic, and dogmatic. But in the notoriously inexact lexicon of twentieth-century American critical jargon these various labels are not necessarily contradictory. As they were applied to Spingarn, they usually referred to the heresy of aestheticism, to the idea that art exists in a vacuum, that "content" is unimportant, and that criticism need not concern itself with judgment. This dissertation is an attempt to determine whether he is guilty of these charges, what his relation was to his contemporaries (especially the sociological critics and the neo-Humanists), and what his influence has been (especially in relation to the so-called "new critics").

To do this job it is first necessary to sketch briefly the biographical facts about Spingarn which enlighten his critical theories. Spingarn's scholarly work, the dispute with Nicholas Murray Butler that preceded his dismissal from Columbia, his candidacy for public office, his service in the Army during World War I, and his editorial work for Harcourt, Brace and Company, to mention only a few of his many activities, suggest Spingarn's versatility. But underlying this versatility were certain principles of character binding his life into unity: pride, honor, zeal, devotion to duty, and a romantic faith in the power of the individual. These principles combined to make Spingarn an enemy of materialism and a disciple of idealism. And it was his philosophic idealism that made him the chief American apologist for the aesthetic of Benedetto Croce.

Spingarn's interpretation of Croce, however, was always conditioned by his desire to combat the particular brands of materialism he thought were smothering the spiritual life of America. Thus, in his early days he emphasized the autonomy of art, its independence from mechanical rules, and its dependence on the creative genius of the individual artist. He wanted to establish the aesthetic experience as a spiritual activity free from sociological determinants and moral and intellectual dogmatism. But he never argued that man was not a social and moral being. In his later years (especially in his unpublished lectures at the New School on Literature and the New Era) he emphasized that both the artist and the critic, the creator and the appreciator, must be complete men, fed by all experience, practical as well as theoretic.

Insofar as Spingarn, in his effort to establish art as a spiritual activity, distinguished it from philosophy, from morals, and from politics (which were also forms of the spiritual life of man), he was dealing with the same problems as were such "new critics" as John Crowe Ransom and Allen Tate. But Spingarn's emphasis on the spiritual nature of art, while not denying the critic's obligation to judge, made it difficult for him to deal with concrete works. And insofar as his aesthetic reduced the critic to silence, Spingarn had little in common with these men.

Spingarn's failure to produce concrete criticism and the difficulty of maintaining an idealistic philosophic position in twentieth-century America probably account for his lack of direct influence on later critics. And his polemical manner of argument deprived him of a hearing among the philosophers. He was caught between the extremes of the journalists and the aestheticians. But his refusal to succumb to the pat theories of his contemporaries and his unflagging championship of the importance of art as art (whatever other importance it might have) were valuable antidotes to the naïveté of critical disputation in the twenties and a stimulus to its growing refinement and sophistication in the thirties and forties.

Microfilm copy of complete manuscript of 707 pages, $8.83. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-438.

STEFAN GEORGE ALS ÜBERSETZER BAUDELAIRES

(Publication No. 4957)

Salo Weindling, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ERNEST JOCKERS

George mag die "Fleurs du Mal" bereits vor seinem Pariser Aufenthalt im Jahre 1889 kennengelernt haben.

Die Unvollständigkeit der Übertragung hat ihren Grund nicht in der Verwerfung der in den

ausgeschalteten Gedichten behandelten Motive, sondern in der Erkenntnis, dass diese an anderer Stelle innerhalb der "Fleurs du Mal" ebenso gut oder besser gestaltet worden sind und jene Gedichte in z. T. zugespitzter Form dem Gesamtbild Baudelaires nichts zufügen.

Die Forschung hat sich nicht selten von der Erwartung leiten lassen, dass in der Umdichtung auf Grund der Unterschiede in der geistigen Grundhaltung und in der Kunstübung der beiden Dichter der Hauch einer der Vorlage fremden Geistigkeit zu verspüren sein werde.

Schon ein Vergleich der endgültigen Fassung der Übertragung mit der "Vorausgabe" führt zu einem Ergebnis, das diese Erwartung nicht rechtfertigt: die weit überwiegende Mehrzahl der Änderungen stellt eine grössere Annäherung an die französische Vorlage dar, während eine nicht unerhebliche Anzahl von Änderungen von der Treue zum üblichen deutschen Sprachgebrauch und eine geringe Anzahl von Georges eigenem Verhältnis zum Dichterischen bestimmt erscheinen.

Der vorherrschende Eindruck, den die Umdichtung vermittelt, ist der der Wort-,Bild- und Sinntreue. Wo der Reimzwang eine Abweichung von Wort- oder Bildtreue bedingt, wird dennoch die Sinntreue nicht beeinträchtigt; zuweilen hat eine derartige Abweichung geradezu den Zweck, den Sinnzusammenhang folgerichtiger herauszuarbeiten.

Die musikalischen Stilmittel Baudelaires, wie Wortwiederholung, Alliteration und Vokalassonanz als Harmonie oder Farbe werden in der Umdichtung an der betreffenden oder an anderer Stelle nachgebildet, während die Wiedergabe des Vokalsymbolismus als Ausdruck seelischer Stimmungen allerdings nur in sehr beschränktem Umfange erreicht werden kann.

Besonders gross ist die rhythmische Treue der Umdichtung da, wo der Alexandriner durch den Fünfheber, der Acht- und der Fünfsilbler durch den drei- bezw.zweihebigen Vers wiedergegeben wird. Den sonettischen Alexandriner überträgt jedoch fast stets der fünffüssige Jambus, um der deutschen Sonnettradition Rechnung zu tragen (wobei die gedrängtere Kürze dieses Verses eine grössere textliche Knappheit bedingt), während bei der (wohl unter dem Einfluss der Sonettübert ragungen erfolgenden) Verwendung dieses Verses zur Wiedergabe des nichtsonettischen Alexandriners versucht wird, das strenge jambische Maass zu lockern, um dem Fluss des Alexandriners gerecht zu werden.

Der Baudelaireschen Dynamik folgend, bildet die Umdichtung das Enjambement der Vorlage an der betreffenden oder, Georges übersetzungstechnischem Prinzip zufolge, an anderer Stelle nach.

In der Übertragung der meisten nichtsonettischen Gedichte entsprechen Reimanordnung und Endungsschema getreu der Vorlage. Auf eine strenge Wiedergabe des sonettischen Reimschemas wird in etwa der Hälfte der Fälle verzichtet, da Baudelaire selbst hauptsächlich das "sonnet irregulier" pflegt; nichtsdestoweniger erscheint das Reimschema,z.T. zusammen mit dem Endungsschema auch in der Umdichtung vieler Sonette genau nachgebildet.

Anderseits ist das Georgesche Element in der Umdichtung nicht zu verkennen.Es verrät sich zunächst im Stilistischen,d.h. in Wortneuschöpfungen, besonders in neuen Substantivbildungen, ferner in eigenwilligen grammatischen Wendungen und in gelegentlicher Sinnverdunkelung, die durch Wortwahl, Wortverknappung und Wortstellung hervorgerufen sein kann, und in der Vorliebe für zusammengesetzte Hauptworte, in denen sich der Wille zum Wesentlichen kundgibt.Gesteigert erscheint dieser Wille in der gelegentlichen Neigung zur Typisierung oder Verallgemeinerung des Besonderen.

Bezeichnend für George ist ferner die Neigung zur Veredlung des Bedeutungsgehaltes einzelner Worte oder ganzer Bilder, womit auch die Ausschaltung des humoristischen Elementes Hand in Hand geht.

Schliesslich bricht hier und da an markanten Stellen der Umdichtung Georges eigene Welt- und Kunstanschauung unzweifelhaft durch.

Sieht man in den "Blumen des Bösen" das Ergebnis eines geistigen Kräfteparellelogramms, des Strebens nach Treue zu Wortlaut,Sinn,Sprachcharakter,Rhythmus,Lautmelodik und Reimtechnik der Vorlage und der gleichzeitigen Wirksamkeit der Georgeschen Eigenart in Stil und Geistigkeit, so erweist sich die Treue zur Vorlage als die stärkere Komponente unter den beiden richtunggebenden Kräften der Umdichtung. Das Ergebnis des Vergleichs von endgültiger Fassung und "Vorausgabe" wird damit bestätigt:die Änderungsprinzipien sind in der Tat Übertragungsprinzipien.

Trotz aller, dem idealistisch-klassischen Naturell Georges entsprechenden Grenzen seiner Übertragungstreue muss die Selbstzucht bewundert werden, mit der ein Dichter von so ausgesprochener Individualität und Unabhängigkeit die Aufgabe der Eindeutschung eines fremden Meisters durchgeführt hat.

Microfilm copy of complete manuscript of 192 pages, $2.40. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-439.

LANGUAGE AND LITERATURE, LINGUISTICS

A GRAMMAR OF TETELCINGO (MORELOS) NAHUATL

(Publication No. 4947)

Richard S. Pittman, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: ZELLY S. HARRIS

This grammatical sketch is based on materials gathered by the author during six years of residence in the Nahuatl-speaking village of Tetelcingo, Morelos, 60 miles southeast of Mexico City. It includes 36 pages of text from three different informants. All morpheme boundaries are indicated, in both text and

translation, to facilitate comparison with, and independent judgment of, the accuracy of the grammar.

The author's paper, The Priority of Valence Over Phonological Attachment and Relative Order in Descriptive Statements, given at the 1952 summer meeting of the Linguistic Society of America, constitutes the bulk of the Introduction. The thesis of this paper is that the morphology-syntax dichotomy and criteria of position, while decidely relevant to descriptive statements, should be oriented to antecedent recognition of 'valences' which are defined as 'bonds' between immediate constituents. A distinction between overt and covert valences is indicated, with some 'morphemes' identified as overt valences.

In carrying out the principle alleged in the introduction, the author divides the grammer into five main headings: I. Basic Sentence Constructions, II. Verb Complex, III. Noun <--Adjective Constructions, IV. Verb< --Adverb Constructions, V. Sentence Satellites and Clause <--Conjunction--> Clause Constructions.

Within this framework the paragraphs of the grammar alternate, in general, between descriptions of morphemes or classes and descriptions of constructions. The sequence of statements is based on a progression from simplest, most presupposed constructions to complex, least presupposed constructions. This leads to a beginning with pronoun subjects and intransitive verb stems. Nouns and their morphology are introduced next, then transitive verb stems with pronoun objects. This progression introduces the reader from the start to the simplest sentence constructions and introduces additional features of both morphology and syntax on the basis, not of 'attachment' nor of 'order', but of relative relevance to the structure of a complete sentence.

The treatment bears many marks of the procedural excellencies introduced by Zellig Harris while retaining those techniques which, in the author's judgment, represent solid elegance in older grammatical descriptions. The influence of Bloomfield, Hjelmslev, and other nineteenth and twentieth century grammarians will be noticed. The traditional terminology of Indo-European grammar has been used, as far as possible, in an attempt at maximum intelligibility.

Some of the features of this dialect of Nahuatl worth remarking are: an extensive use of complex honorific forms, uniform penultimate stress, relatively slight morphophonemic variation, quite complete 'long-short' vowel contrast (now lost in many dialects), rarity of one-morpheme words, required object pronoun with transitive verb stems, complexity and variety of alternants of plural morpheme, aspect and directional morphemes, reduplication as alternant of both singular and plural morphemes, and basically present, vs. basically preterit, stems.

An explanation of apparatus, summaries of phonemes and morphophonemics, charts of irregular verbs, index of verb and noun affixes and clitics, and a selected list of verb stems, with roots indicated, complete the work. Description of derivational constructions has not been attempted.

Microfilm copy of complete manuscript of 125 pages, $1.56. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-440.

MATHEMATICS

ESTIMATION OF THE DOSAGE MORTALITY RELATIONSHIP WHEN THE DOSE IS SUBJECT TO ERROR

(Publication No. 4668)

Kenneth David Cann Haley, Ph.D.
Stanford University, 1953

This paper presents an outline of the various models and estimation procedures available for the investigation of the dose response problem. The non-error probit and logit models are compared analytically, and the difference between them is shown to be negligible for practical purposes. Models are presented for the case of error in the dose. In general if for known dosage the probability of a response is

$$P = \int_{-\infty}^{\alpha + \beta x} f(t)\, dt,$$

and if the dose d, has a density given by $g(d,\theta)$, then the expected proportion responding is given by

$$U = E(P) = \int_{-\infty}^{\infty} \left[g(d,\theta) \int_{-\infty}^{\alpha + \beta x_d} f(t)\, dt \right] dd.$$

For known θ, maximum likelihood estimates of α and β may be obtained.

The Poisson error model is worked out in detail and numerical estimates are computed as an illustrative example. In this case

$$U = \sum_{d=0}^{\infty} \frac{e^{-h} h^d}{d!} \int_{-\infty}^{\alpha + \beta \log d} \frac{1}{\sqrt{2\pi}} e^{-t^2/2}\, dt,$$

where h is the expected dose given. Some comparisons between models in the error and non-error cases are shown and recommendations made for use in either case. Finally a proposal for tabulating the functions in the error estimation procedure is outlined.

Microfilm copy of complete manuscript of 53 pages, $1.00. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-441.

SYMMETRIZATION IN N DIMENSIONS

(Publication No. (4679)

Simon Herold Lachenbruch, Ph.D.
Stanford University, 1953

The main subject of this paper is a generalization of the following theorem: If the two plates of a condenser are given Jordan surfaces, each of which encloses a given volume, and one of which lies inside the other, the electrostatic capacity of the condenser is a minimum when the plates are concentric spherical surfaces.

The generalization in question proceeds in two directions. The first of these, which is not new, involves the concept of symmetrization of a Jordan surface and the three-dimensional solid which it encloses. (a) Symmetrization of a Jordan surface with respect to a given point means the replacement of the surface by a spherical surface of equal volume with center at the given point. (b) Schwarz symmetrization of a surface with respect to a given line is a transformation which replaces the surface by a second surface which encloses the same volume but is axially symmetrical with respect to the given line. The areas of the intersections of the two surfaces with any plane orthogonal to the given line are equal. (c) Steiner symmetrization of a surface with respect to a given plane is a transformation replacing the surface by one which encloses the same volume but has mirror symmetry with respect to the given plane. Again, any line orthogonal to the given plane intersects the two surfaces in segments whose total lengths are the same.

The theorem above may be reworded by stating that symmetrization of the two plates of the condenser with respect to a point decreases (or leaves unchanged) its capacity. The first generalization states that Schwarz and Steiner symmetrization also have this effect on capacity.

The second direction of generalization, which constitutes the central theme of this paper, involves the extension from three-dimensional to n-dimensional Euclidean space, in which all needed concepts are defined as abstract generalizations of their counterparts for n=0,1,2, and 3. A single definition of symmetrization in n-space is so constructed that the three types listed above are special cases for n=3. Similarly, capacity in n-space is abstractly defined in such a way as to reduce to the familiar electrostatic capacity when n=3; and it is pointed out that the generalized concept has a concrete physical meaning also when n=2 and n=1.

The main theorem, here proved by two independent methods, is that n-dimensional capacity is always reduced (or left unchanged) by any n-dimensional symmetrization.

As an important intermediate theorem, it is proved that symmetrization decreases the surface area. This is the generalization of the classical isoperimetric inequality, in exactly the same sense that the main theorem is the generalization of the theorem stated at the beginning of this abstract.

Another type of symmetrization which is investigated briefly is the n-dimensional generalization of spherical symmetrization, whose definition resembles that of Schwarz symmetrization but involves the intersection of the given surface with concentric spherical surfaces rather than with parallel planes.

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THE GENERALIZATION OF THE PRINCIPLES OF SOME MODERN EXPERIMENTAL DESIGNS FOR EDUCATIONAL AND PSYCHOLOGICAL RESEARCH

(Publication No. 4868)

William Jeane Moonan, Ph.D.
University of Minnesota, 1952

It was a stated purpose of this thesis to present the theoretical and analytical aspects of multivariate analysis of variance for some useful experimental designs. The author's intention was to make this presentation understandable and useful to research workers in the fields of psychology and education. Ordinarily these individuals do not have the opportunity to take advanced courses in mathematical statistics wherein some of the theory given here would be presented, but they do have the ability to comprehend and put it to good uses.

The fact that the principles and application of multivariate analysis of variance are lacking in psychological and educational literature made it necessary to devote several sections of the second chapter to the discussion of the advisability of using the multivariate approach to the design of experiments. These discussions pointed out the fact that single dependent variates do not often capably define the concept under investigation and, further, that repeated analyses of different correlated variates from the same individuals make it difficult to assign correctly the exact probabilities of rejection or acceptance of the hypothesis under test.

These difficulties are avoided in the applications of multivariate analysis of variance since the complex criteria of the analysis may be considered as matrix variates and the significance tests of multivariate linear hypotheses may be made independently of nuisance parameters. The matrix variates may take multifarious forms of which scholastic achievement and psychotic behavior are but two examples.

After a chapter on basic mathematical and statistical principles, the procedures of analysis of variance are generalized to the multivariate case using the principles learned in the lectures and notes

of Professor Raj Chandra Bose at the University of North Carolina. These generalized principles included the concept of estimable parametric functions which plays an important part in the tests of the general linear hypothesis.

The main part of this thesis is the chapter devoted to specific designs for which the theory, assumptions and calculations of specific examples are given. The designs so considered are:

1. Hotelling's Generalization of Student's t. The data of the example used for this problem are part of Dr. H. Van Alstine's thesis and related to the honor point ratios of women university students living at home.

2. Hotelling's Generalization of Fisher's t. Dr. H. Kruglak's data on the performance of American Studies and Physics majors on the electromaze were used to illustrate this test.

3. The Generalization of the K-Sample Problem. An experiment which involved the teaching of geometry using visual aids illustrated this test and the data were taken from Dr. D. A. Johnson's thesis.

4. The Generalization of the Two-Way Classification Problem With One Observation in the Sub-groups.

Some data used in a study by Dr. C. Stokes which involved different methods of teaching ninth grade algebra is given for the illustration. A detailed comparison between the multivariate and univariate analyses of the same data is made and shows the advantages of multivariate analysis of variance. A second illustration was made for this problem which gives the multivariate generalization of Dr. C. Hoyt's method of obtaining an estimate of the reliability of an examination. Some data of test-retest scores of grade school children's aptitudes, as provided by Dr. M. Van Wagenen, are used in the illustration.

5. The Generalization of the Two-Way Classification Problem With Equal Numbers of Observations in the Sub-groups.

Data from Dr. H. Kruglak's thesis on teaching laboratory physics are used here.

6. The Generalization of the Three-Way Classification Problem. This example analyzed a drawing experiment as reported by Dr. C. Hoyt et al.

7. The Generalization of the Latin Square. Original data of the problems were collected by the author in the form of diagnostic test scores on students' abilities to solve simple algebraic equations.

8. The Simple Multivariate Regression Model. This model is used to test the hypothesis that there exists no regression of a matrix variate on an independent variate. This model provides the basic form which is used in multivariate analysis of covariance problems.

A survey of the technical and practical literature on multivariate analysis of variance problems is given also.

Microfilm copy of complete manuscript of 225 pages, $2.81. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-443.

A GENERALIZATION OF THE POISSON FORMULA FOR THE SOLUTION OF THE HEAT FLOW EQUATION

(Publication No. 4886)

Arnold Jackson Tingley, Ph.D.
University of Minnesota, 1952

R. H. Cameron has studied the boundary value problem

$$\text{(1a)}\quad \frac{\partial^2 G}{\partial \xi^2} - a\frac{\partial G}{\partial t} + \theta(t,\xi)G = 0 \qquad a>0$$

$$\text{(1b)}\quad \lim_{\xi \to \pm\infty} G(t,\xi) = 0 \qquad 0< t \leq t_0 \text{ (fixed) } t_0 >0)$$

$$\text{(1c)}\quad \text{l.i.m.}_{t\to 0^+} G(t,\xi) = \sigma(\xi) \qquad -\infty < \xi < \infty,$$

where $\theta(t, \xi)$, together with its first partial derivatives $\theta_t(t,\xi)$ and $\theta_\xi(t, \xi)$, are continuous functions of (t, ξ) in the region R: $0 \leq t \leq t_0$, $-\infty < \xi < \infty$, and where $\sigma(\xi)$ is of class L_1 on $(-\infty,\infty)$, and $\theta(t, \xi)$, $\theta_t(t, \xi)$ and $\theta_\xi(t, \xi)$ satisfy certain boundedness conditions. The solution is

$$\text{(2)}\quad G(t,\xi) = \int_C {}^{w}\, e^{\frac{t}{a}} \int_0^1 \theta\left[t(1-s),\ 2\sqrt{\frac{t}{a}}x(s) + \xi\right] ds \cdot \sigma\left[2\sqrt{\frac{t}{a}}x(1) + \xi\right] d{}^{w}x.$$

Here C is the space of continuous functions defined on $[0,1]$ which vanish at the origin, and the symbol $\int_C {}^{w} F(x) d_{w}x$ denotes the Wiener integral of the functional F(x).

With a different type of boundary condition, a more general form of this differential equation was studied earlier by M. Rosenblatt.

Cameron made the following restrictions on $\theta(t, \xi)$, $\theta_t(t, \xi)$ and $\theta_\xi(t, \xi)$;

$$\theta(t, \xi) \leq B_1,$$

$$|\theta_t(t,\xi)| \leq B_2 e^{\beta_3|\xi|}, \quad |\theta_\xi(t,\xi)| \leq B_2 e^{\beta_3|\xi|},$$

where B_1, B_2 and B_3 are arbitrary non-negative constants.

It is the purpose of this paper to show that these conditions can be considerably weakened. Our main result is the following theorem.

Theorem. Let $\theta(t, \xi)$ and its first partial derivatives $\theta_t(t, \xi)$ and $\theta_\xi(t, \xi)$ be continuous functions of (t, ξ) in the region of R: $0 \leq t \leq t_0$, $-\infty < \xi < \infty$, and satisfy in R the following conditions;

$$\theta(t,\xi) \leq c\,\xi^2 + B_1,$$

$$|\theta_t(t,\xi)| \leq B_2 e^{\beta_3 \xi^2},$$

$$|\theta_\xi(t,\xi)| \leq B_2 e^{\beta_3 \xi^2},$$

where c, B_1, B_2 and B_3 are non-negative constants. Let c and B_3 satisfy the inequality

$$c + \frac{a\pi^2}{2t_0} B_3 < \frac{a^2\pi^2}{16\, t_0^2}.$$

Assume also that $\sigma(\xi)\, e^{b\xi^2}$ is of class L_1 on $(-\infty,\infty)$, where b is a non-negative constant satisfying

$$b \geq \frac{1}{2}\sqrt{c}\, \tan \frac{2t_0\sqrt{c}}{a}.$$

Then $G(t,\xi)$ as defined in (2) is a solution of the system (1). Moreover, if $\sigma(\xi)$ is continuous at ξ_0, then

$$\lim_{\substack{t \to 0^+ \\ \xi \to \xi_0}} G(t,\xi) = \sigma(\xi_0).$$

Microfilm copy of complete manuscript of 49 pages, $1.00. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-444.

MUSIC

A STUDY OF THE RELATION BETWEEN CERTAIN MENTAL AND PERSONALITY TRAITS AND RATINGS OF MUSICAL ABILITIES

(Publication No. 4496)

John Christopher Cooley, Ed.D.
Michigan State College, 1952

The Background of the Problem

Within the past three decades, research in music education has outlined, broadly, two points of view as to the nature of musical talent. The differences between these two points of view have largely been due to differences in approach and technique of study.

Talent testing. One approach can be categorized broadly as being concerned with talent testing. Seashore,[1] the most widely known of musical talent testers, selected certain psychological and aural factors of musical talent and constructed tests designed to measure these factors. His approach to the enigma of musical talent was an analytical one. Seashore speaks of this approach as "...the specific theory of measurement."[2] By this is meant that each specific subtest in the Seashore battery must be validated in terms of the specific thing that it is supposed to measure, rather than in terms of complex musical functions or gestalten.

The Seashore tests and other talent tests of a similar nature have been used in numerous research studies which can be summarized broadly as follows: Musical talent test scores have not been found to be closely correlated with intelligence or with various personality traits. These findings have resulted from cross-sectional types of studies.

A second approach to the study of musical talent has been that of several German researchers. This approach to the problem of musical talent has been, for the most part, a "gestalt" approach using broad, functional criteria of musical talent. In a summary of some of these studies Mursell[3] points out that these findings indicate a high relationship between musical ability and general ability. Mursell points out, (in a second summary of several of these studies), that these findings indicate that "...the very musical child inherits a general high grade personality."[4]

The present study was an investigation to determine the feasibility of using a psychometric approach to the study of musicality and to determine, in a college situation, the relation of certain psychological measurements (standardized test scores) to general musicality and to functional musical abilities, determined by ratings made by professionally qualified people.

Method of Study

A group of 180 undergraduate music students at Michigan State College were utilized in the study. The following tests were administered to this group of music students: (1) American Council on Education Psychological Examination. (2) Cooperative Reading Comprehension Test. (3) The Personality Inventory of Robert G. Bernreuter. (4) Seashore Measures of Musical Talent, 1939 revision. Ratings of Musicality, Sight-Reading Ability, and Performance Ability were made by the 51 members of the music faculty of Michigan State College. To supplement these indices of musicality, applied music grades were included in the data.

Results

All the distributions of total and sub-scores of the intelligence, reading, and musical talent tests were skewed negatively with modal concentrations of scores at the tenth decile. All averages of these total and sub-scores were higher than those of unselected college groups that have taken the various tests. These differences were statistically significant beyond the one per cent level of confidence. The test performance of these groups was interpreted as indicating that high intelligence, reading ability, and Seashore test scores go with musicality. Correlation coefficients between these several test scores and ratings of Musicality and Sight-Reading ability were low, this relation being best indicated by a coefficient of approximately .25.

The means of several of the Bernreuter sub-scores were significantly different from estimated means of unselected college groups. Significant differences were found for the means of the Neuroticism, Introversion, Confidence, and Sociability scores. This was taken as evidence that college music students

tend to differ in personality profile from unselected college students. Correlation coefficients between these personality scores and ratings of Musicality, Sight-Reading, Performance, and applied music grades were very low, none of them significant and not differing, demonstrably, from chance correlations.

Summary

(1) There is evidence that high intelligence and high reading ability, as well as superior performance on the Seashore tests, tend to go with musicality. There is evidence that there is a slight significant correlation between intelligence and reading ability rankings, and ratings of Musicality and Sight-Reading ability. (2) There is evidence that the personality profile of the college music student differs from that of the unselected college student. There is no evidence that personality traits are correlated with musicality, or with ratings of functional musical abilities.

1. Carl E. Seashore, J. G. Saetveit, and Don Lewis, Manual of Instructions and Interpretations for the Seashore Measures of Musical Talent, New Jersey: RCA.

2. Saetveit, J. G,, Carl E. Seashore, and Don Lewis, Revision of the Seashore Measures of Musical Talent. Iowa City: University of Iowa Press, 1940, p. 48.

3. James L. Mursell, "Intelligence and Musicality," Education, 59:559-562, 1939.

4. J. L. Mursell and M. Glenn, Psychology of School Music Teaching. New York: Silver Burdett Co., 1938, p. 36.

Microfilm copy of complete manuscript of 187 pages, $2.34. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-445.

INVESTIGATION AND EVALUATION OF AUDIO-VISUAL MATERIALS PERTAINING TO THE UNDERGRADUATE MUSIC EDUCATION CURRICULUM

(Publication No. 4697)

Harry E. Holmberg, Ed.D.
Florida State University, 1953

The purpose of this study was to investigate audio-visual materials and to evaluate them in terms of their suitability for use in the undergraduate music education curriculum. This study was initiated on recommendation of the Research Council of Music Educators National Conference. It makes available for the first time a bibliography of materials within the described limits, data as to production and source, a full description of the aid, a statement as to the maturity level and an evaluation based on criteria evolved at the outset. In addition, a composite undergraduate music education curriculum has been formulated and the materials categorized as to their usefulness in the various areas of study. Conclusions have been drawn as to the effectiveness of existing materials and recommendations are made as to the development of additional audio-visual materials and methods.

The materials evaluated in this study were obtained from commercial audio-visual and film libraries, college and university audio-visual centers and music supply houses. Periodicals, books and theses concerned with the utilization of audio-visual materials in education and music education in particular were consulted for additional materials. Each aid included in the study has been personally examined by the author and evaluated in accordance with criteria established in the music education evaluation form prepared for this study.

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PHARMACOLOGY

STUDIES ON THE RENAL TUBULAR SECRETION OF POTASSIUM AND THIOSULFATE IN THE DOG

(Publication No. 4558)

Paul Brazeau, Ph.D.
Columbia University, 1952

Part One: The excretion of potassium during three-hour infusions of 400-500 mEq./min. of isotonic potassium sulfate was observed in 23 experiments before adrenalectomy and in 9 experiments after adrenalectomy in four female dogs. In the experiments after adrenalectomy, severe circulatory insufficiency intervened during the second or third hour of the infusion. However, as long as circulatory competency prevailed, the excretion of potassium seen after adrenalectomy was quite similar in pattern and magnitude to that seen in the intact dog. It is concluded that the renal tubular secretion of potassium is not dependent on direct control by the adrenal cortex.

Part Two: In trained normal female dogs which initially showed $C_{S_2O_3}/C_{Cr}$ ratios of unity, a large net secretory transport of thiosulfate was induced by the chronic administration of cortisone (100 mg./day) or testosterone (50 mg./day). Net secretion of thiosulfate was evident after two days and reached a maximum within nine days. This effect is attributed to the renotrophic action of

androgenic steroids. The induced renal tubular transport of thiosulfate is markedly depressed by carinamide and a small amount of tubular reabsorbtion is then seen. Thiosulfate secretion is not reduced by benemid, dehydroacetate, 2,4-dinitrophenol, mercupurin or by the simultaneous renal tubular transport of the organic anions PAH and Diodrast. It is enhanced by the infusion of sodium acetate or bicarbonate, but not by brisk infusions of sodium sulfate. Therefore the effect of the infusion of bicarbonate or acetate is not attributable to the osmotic diuresis induced. The significance of the similarities and differences between the transport of the organic anions and thiosulfate transport is discussed. It is suggested that although under most circumstances the net tubular reabsorbtion or secretion of thiosulfate is small, the use of this ion for precise measurements of the rate of glomerular filtration should be abandoned.

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PHILOSOPHY

ARISTOTLE'S CRITICISM OF PLATO'S TIMAEUS

(Publication No. 4916)

George Stuart Claghorn, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: PAUL ABRECKY - Substituting for GLENN R. MORROW

Did Aristotle agree with Plato, or did he not, and to what extent? The solution of that problem has far-reaching consequences. It governs the interpretation of their writings and the evaluation of their influence; it determines the criteria for judging both their exponents and their critics. This dissertation dealt with one aspect of that problem; its purpose was to discover the meaning of Aristotle's criticisms of Plato's Timaeus.

The Timaeus was selected because it is the Platonic dialogue most often referred to by Aristotle. Throughout antiquity and the middle ages, it was usually considered Plato's most important work. It is the only one in which he attempts a comprehensive treatment of natural science. The dissertation, therefore, is really a treatment of Aristotle's criticism of Plato's view of natural science.

Aristotle's references were divided into seven general topics, namely, the Receptacle, simple bodies, qualities, motion, time, the soul, and scientific method. The views of Plato and Aristotle on these subjects were analyzed. In the light of this study, Aristotle's criticisms in each case were examined. The attempt was made to determine why the criticisms were made, and the nature of Aristotle's attitude and philosophic relationship to Plato, as expressed in them.

Conclusions

Aristotle's criticisms of the Receptacle indicate that he understood the role it filled in Plato's doctrine. The Receptacle is not empty space — contrary to many interpretations — but corresponds to Aristotle's "prime matter." Aristotle did not employ plane-figures in describing the four earthly "elements," but he did not disagree with such a treatment of them by Plato. Aristotle and Plato held in common that qualities arose from bodies which were extended in space, material, and full of potencies. They differed on the cause of weight, but agreed that this makes no difference in experience as we know it.

Also, it was found that every kind of earthly motion proposed by Aristotle is found previously in the Timaeus. Plato and Aristotle are in accord that the earth is not a planet, but instead, a body at rest at the center of the universe. They do not differ on the characteristics of time, although they define it differently, due to their individual approaches. Neither thought that time had a literal beginning.

Another conclusion is that Aristotle decisively rejected both the Demiurge and World-soul of Plato, but retained most of the content Plato intended by them. He accepted his master's distinction of two types of cause (mechanical and rational), and like him asserted the supremacy of the rational everywhere.

Plato should be reinstated to a place of importance in the history of science. He stressed the necessity of both observation and reason, and the use of mathematics. Plato also recognized that there were certain principles of universal applicability, characterized by regularity and simplicity. He gave scientific research a tremendous impetus.

Both Plato and Aristotle were opposed to the ex parte explanations of the Pythagoreans and Atomists. Aristotle's criticisms are usually constructive rather than destructive, with respect to Plato's doctrines. They are usually directed against misinterpretations of the Timaeus, rather than at the work itself. Neither rational elements nor extended material is adequate to explain the world; both aspects must be considered together. The chief feature of the universe is teleology, expressed in Plato through aetiology and in Aristotle through function.

The conclusion of this study is, therefore, that Aristotle, in his criticisms of the Timaeus, correctly reported and understood it. Although Aristotle often

treated questions in a brilliant, original manner, in his emphases he largely agreed with Plato.

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AN EXAMINATION OF C. D. BROAD'S MORAL PHILOSOPHY

(Publication No. 4888)

Robert George Turnbull, Ph.D.
University of Minnesota, 1952

This thesis attempts (a) to state the positions (together with the arguments for them) which Professor C.C. Broad has held in moral philosophy since 1914, (b) to criticize each of those positions, and (c) to state and offer further arguments for a moral philosophical position which is not open to the criticisms mentioned in (b). Ancillary to these are discussions and criticisms of Broad's analyses of such notions as 'act,' 'intention,' 'motive,' 'moral emotion,' etc. —psychological notions which have an intimate connection with certain more strictly ethical notions and which are such that a wrong analysis of them is apt to lead to a wrong analysis of the ethical notions. In discussing Broad's inaugural lecture on becoming Knightbridge Professor of Moral Philosophy in the University of Cambridge, the problem of the relation between obligation and ability is given a considerable airing; and the thesis attempts to impugn the rather disastrous conclusions of Broad, in that lecture, that 'ought' judgments have no application.

The positions which Broad has held in moral philosophy have been those which, speaking generally and in his words, "most competent persons" have been tempted to hold. He has argued for different forms of non-naturalism, a form of the emotive theory, a form of "imperativism," and what he calls "the trans-subjective, dispositional form of the Moral Sense Theory." If these are the main tenable positions in moral philosophy (and I do not think it a complete listing), then serious criticism of all of them and of the arguments which Broad adduces for them ought to have more general interest than the thesis title may suggest.

It is the main contention of the thesis that (to echo Prichard's words) "moral philosophy (or, at least, much of what claims that title) rests on a mistake." Again echoing Prichard, it is thought that this "mistake" is part of parcel of a fundamental epistemological "mistake." Beyond this point, the parallel with Prichard ceases. The contention of the thesis is that the "mistake" is the confusion of what might be called "conceptual" meaning with "applicative" meaning. The emotivist or naturalist, by confusing the two, is apt to deny that ethical terms have conceptual meaning (or "unique" conceptual meaning) on the ground that they do not occur properly in "factual" discourse. The non-naturalist, by confusing the two, is apt to draw the puzzling conclusion that the ethical terms both belong and do not belong properly in "factual" discourse.

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PHYSICS

PHYSICS, GENERAL

THE CALCULATION OF ELECTRONIC ENERGY BANDS IN SOLIDS BY A VARIATION-ITERATION METHOD

(Publication No. 4918)

Milton Dank, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: HERBERT B. CALLEN

The calculation of the electronic energy band structure for periodic potentials is the fundamental problem of the theory of the solid state. The conventional method of procedure is to form a determinantal wave function consisting of one-electron wave functions which are solutions of the Hartree-Fock equations. The solution of the Hartree-Fock equations is usually accomplished by means of the Wigner-Seitz technique which uses a spherical approximation to the true polyhedral crystal lattice space and is severely limited by the labor involved in satisfying boundary conditions even at a small number of points.

This thesis proposes a new approach to the energy band problem which retains the polyhedral symmetry and avoids the matching of wave functions at the boundary of the unit cell. The integral equation representation of the Schroedinger equation is the basis of this approach. It is shown that the volume of integration may be taken to be a convenient subvolume of the unit cell by the introduction of a kernel (called the "lattice scattering kernel") which is a sum over the lattice sites. This kernel plays an important role in problems involving the interaction of particles and radiation with the ions of the crystal lattice.

The solution of the integral equation is accomplished by means of a method of successive iteration and variation (SIAV); this technique is shown to represent a great improvement in convergence of the iterates over the "power series" iteration method

which has been applied to many physical problems. It is pointed out that the results of the simple iteration method may be immediately improved with a negligible amount of extra labor by means of the SIAV method and several examples, chosen from nuclear physics and other branches of physics, are given.

As a test of the method, the valence band width and the energy gap in diamond are calculated. The crystal potential used is calculated from the free carbon atom potential assuming a $(1s)^2\ (2s)\ (2p)^3$ electronic configuration and includes a free-electron exchange correction term computed by Slater's method. It is found that symmetry considerations permit the calculation of the lattice scattering kernel (LSK) for diamond from the LSK for one of the two face-centered cubic lattices composing the diamond structure. Bloch wave functions (which are shown to be invariant in form under the integral transformations) are formed from the atomic wave functions for the free carbon atom and these are iterated point-by-point on a mesh in the sub-volume of the unit cell for diamond. By symmetry, this determines the wave function throughout the unit cell and, from periodicity, throughout the lattic. The choice of the energy zero and the symmetry of the initial Bloch wave function is shown to determine the convergence of the iterates to the desired eigenstate.

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RECONSTRUCTED WAVE-FRONT MICROSCOPY

(Publication No. 4663)

Hussein Mohammed Amin El-Sum, Ph.D.
Stanford University, 1953

The resolution of ordinary types of microscopes (refraction or reflection) is limited either by geometrical and/or diffraction aberration. This is not the situation in reconstructed wave-front microscopy (sometimes referred to as diffraction microscopy). The author has carried out a detailed study both theoretically and experimentally of this new type of microscopy.

A small object is illuminated by a monochromatic small source and the resulting diffraction pattern is photographed. This photograph, called a hologram, when suitably illuminated, can reconstruct two images of the original object. A hologram can be produced in the above-described way, or by photographing an out-of-focus image of an object, formed by lenses or mirrors.

The properties of holograms have been tested by using the same or different wavelengths for the production and the reconstruction.

Methods have been developed for suppressing all of the hologram noise resulting from dirt, defects in glass parts, and optical non-uniformity of the photographic film base. The reconstructed image, even from a clean hologram, suffers from noise. The origin of this noise has been traced, and methods have been developed for the suppression of most of it.

A new idea is proposed by the author to reconstruct one image rather than two. The theory of this idea is presented, and an experimental arrangement is suggested.

Holograms produced by x-rays and electron beams have been successfully reconstructed by visible radiation, and photographic prints of such holograms and their reconstructed images are presented.

Holograms can also be produced by radiation far from monochromatic. Discussion of this topic as well as others is presented. Some of the other topics that have been covered are:

1. The size of the illuminating source and its effect on the quality of the reconstructed image.
2. The resolution limit and the factors upon which it depends.
3. The relative importance of the number of fringes in the quality of reconstruction.
4. Effect of astigmatism in the illuminating radiation.
5. Time of exposure for producing a hologram.
6. Type of objects to be used.
7. Reconstruction of a sharp edge (an opaque half-infinite plane).
8. Use of diffraction microscopic idea to improve the resolution of the existing types of microscopes.

In agreement with the theory, it has been found that the resolution of a reconstructed wave-front micrograph made with a given lens surpasses that of any image directly formed by the same lens.

On the other hand, reconstruction of objects having weak background has been carried out experimentally, but could not be verified theoretically.

Several suggestions are presented for further studies in the various phases of the field.

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ON THE MAGNETIC INTERACTIONS IN THE THEORY OF ATOMIC SPECTRA

(Publication No. 4925)

Howard D. Goldgraber, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: C. W. UFFORD

An investigation is made of the relative magnitudes of the second-order magnetic interactions in the theory of atomic spectra. By the use of an electronic digital computer, the eigenvalues of the entire electrostatic plus spin-orbit matrix are solved for in the vSL scheme and the intervals calculated.

The second-order spin-orbit interaction, i.e., the

non-diagonal elements of the spin-orbit matrix, is shown to be, in most terms, the largest single second-order effect on the intervals of terms in the iron group elements, which is contrary to the results of Araki (1948). However the second-order spin-orbit interaction does not dominate the other second-order effects (such as spin-spin and spin-other-orbit) and in one special case the spin-spin interaction is seen to be the most important second-order effect for explaining deviations from the Lande rule. A rule of thumb for the location of similar cases is given.

The effect of adding a correction term, $\alpha L(L+1)$, to the Slater first order theory is investigated for several spectra and the values of α are found to be positive and in the same range as previous results. The possibility that the correction is due to "orbit-orbit" interaction is discussed and a theoretical relation is derived for predicting roughly the values of α in unknown spectra.

An expression is derived for the effect of the interaction between 1^n and $1^{n-1}1'$ configurations on the interval structure. Evidence is adduced that this effect, though quite small, is detectable in the spectra of Mo II.

The matrix elements of spin-other-orbit interaction for d^3 configurations are derived using the Racah tensor algebra methods.

The term values and intervals of the deep even configurations of Mn III, Cr II, Cr III and Mo II are analyzed to illustrate the various effects discussed above. Consideration of the interaction between the d^5 and d^4s configurations in Mo II is shown to improve the agreement between theory and experiment. Also it is demonstrated that interaction with the d^3s^2 configuration must be included in any configuration interaction calculation for the deep even terms of Cr II. Some term assignments in Cr III are shown to be very probably incorrect and the positions of unknown terms in the various spectra are predicted.

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LIQUID SCINTILLATION COUNTERS AND THEIR APPLICATION TO THE MEASUREMENT OF THE NEGATIVE μ-MESON CAPTURE PROBABILITY IN THE HEAVY ELEMENTS

(Publication No. 4837)

Francis B. Harrison, Ph.D.
Princeton University, 1951

The experiment described in this thesis consisted of two parts. In the first, the liquid scintillation counter was developed; in the second, it was used in a cosmic ray measurement.

The first part of the thesis gives the results of an investigation into the properties of scintillation counters consisting of solutions of aromatic hydrocarbons in organic solvents. Of all the materials investigated, Terphenyl proved to be by far the best. The light output of a solution of Terphenyl in Toluene or Xylene is comparable to, but smaller than, the light output of a crystal of Anthracene or Stilbene. In a saturated solution, a minimum ionizing particle is shown to produce one photon for every 150 ± 50 electron volts of energy loss.

The physical process in a scintillation in one of these solutions is discussed. We can arrive at a qualitative description of the excitation mechanism, but the state of the theory is not such as to allow exact calculations.

In the second part of the thesis we describe a measurement of the negative μ-meson lifetime in Copper and Antimony. The results, together with the values given by Ticho and Valley for the lifetime in the lighter elements, confirm Wheeler's fourth power law for the capture probability, and allow a better estimate of Z_0, the atomic number of an idealized nucleus for which capture and decay compete on equal terms. This in turn offers hope of yielding a better value for the μ-meson - nucleon coupling constant, a knowledge of which would be helpful in the investigation of the basic similarities between the processes of beta - decay, μ-meson decay and μ-meson capture.

Microfilm copy of complete manuscript of 141 pages, $1.76. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-453.

THE AVERAGE ENERGY REQUIRED FOR THE FORMATION OF AN ION-PAIR BY THE TOTAL ABSORPTION OF 1000 VOLT ELECTRONS IN AIR

(Publication No. 4711)

Frederick William Kuether, Ph.D.
Michigan State College, 1951

An instrument has been constructed for the measurement of the ionization properties of slow electrons in gas. Preliminary measurements indicate that 1032 ev electrons totally absorbed in air produce $27.5 \pm 3\%$ ion-pairs on the average. This allows the determination of W, the average energy required for the formation of an ion-pair, to be 38.5 ev $\pm$ 4.5% for the particular case of 1000 ev electrons absorbed in air.

The method of measurement, which appears quite simple, consists of a comparison of the current due to positive ions removed from the ionization chamber by suitable electric fields with the current due to the electrons entering the ionization chamber. The ratio of these currents, which of course cannot be measured simultaneously, yields K, the average number of ion-pairs formed per initial low energy electron. If the low energy with energy E ev produces K ion-pairs per initial electron, W, the average energy required for the formation of an ion-pair is given by the ratio E/K.

The present instrument is capable of measuring

R, the range of electrons, as well as W for electrons of energy, between 200 ev and 2000 ev. With this information and the experimentally known specific ionization ion-pair formation per unit track length, the experimentally difficult to measure s, the total track length, may be determined as a function of initial electron energy.

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INFRA-RED OPTICAL PROPERTIES OF TELLURIUM CRYSTALS

(Publication No. 4942)

Joseph John Loferski, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: P. H. MILLER, JR.

The fundamental optical absorption and the associated photoconductivity of single crystals of tellurium has been investigated. The crystals exhibit dichroism in the infra-red, i.e., the absorption constant depends on the polarization of the incident radiation. At 300°K for radiation polarized perpendicular to the C axis the absorption edge, located by means of an arbitrarily chosen criterion, is at 3.82 microns ($.324_{ev}$); for the case of polarization parallel to the C axis the same criterion locates the new edge at 3.29 microns ($.374_{ev}$). Since the edge should correspond to the energy gap in tellurium, these results are interpreted to mean that the energy required by an electron to make the transition from the filled to the conduction band depends on the direction of the K vector for the electron. This should be compared to energy gap as computed from intrinsic properties, viz. 0.34 e.v. and to the slope of the intrinsic conductivity vs. temperature curve, viz. 0.328 e.v.

Supporting evidence for different shapes of the energy vs. K curves for the electron in the anisotropic tellurium lattice can be derived from the fact that the difference between absorption constants survives at wavelengths beyond the edges. This behavior can be explained by the classical theory for the absorption of radiation by free carriers, and the resulting analysis indicates that the effective masses of the carriers for the two directions of motion in the crystal have a ratio of approximately 2. The computed ratio of the effective masses exhibits fair correlation with the anisotropy in diamagnetic susceptibilities, as measured by Rao.

The shift of the energy gap with temperature has also been determined and the value obtained was -2×10^{-5} ev/oC i.e., the energy gap decreases with increasing temperature. A cursory examination of the theory would suggest that this value is in disagreement with the theoretically predicted shift. A closer inspection reveals, however, that the theory in the unmodified form is inadequate for a description of the effect of thermal vibrations of the lattice on the gap width of the tellurium crystal. The observation of a larger shift in tellurium by Moss is attributed to the peculiar criterion he used to establish the photoconductive threshold.

The photoconductivity which is barely detectable at room temperature is considerably enhanced by a reduction of the temperature to 90°K. The spectral response indicates the presence of two peaks corresponding in position to the absorption edges. Measurements of the dependence of photoresponse on voltage, light intensity and shuttering speed indicate that the photoconductivity is in conformity with the monomolecular model. Thus tellurium is a high dark current photoconductor.

Selenium - Tellurium alloys containing 5 and 10% selenium by weight and therefore, possessing a considerably reduced lattice volume, show a shift of photoconductivity and transmission toward shorter wavelength, i.e., larger energy gaps. This result is in agreement with Hall's unpublished results on the change of gap width as inferred from intrinsic conductivity measurements, although it contradicts Bridgman's experimental observation that the energy gap in pure tellurium decreases as the lattice volume decreases.

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DETERMINATION OF THE CROSS SECTION FOR THE PRODUCTION OF PROTONS BY THE DEUTERON BOMBARDMENT OF He^3 AS A FUNCTION OF PROTON ANGLE AND DEUTERON ENERGY

(Publication No. 4891)

John Leonard Yarnell, Ph.D.
University of Minnesota, 1952

Monoergic deuterons from the Minnesota electrostatic generator were used to bombard a thin gaseous target of He^3. Protons resulting from the reaction $D + He^3 \longrightarrow He^4 + P + 18.341$ Mev were detected in a sodium iodide scintillation counter. Observations were made between the angles of 15° and 135° at deuteron energies of .260, .455, .978, 1.51, 2.01, 2.50, 3.01 and 3.56 Mev. Additional measurements were made at a fixed angle of 86° in the laboratory, between the deuteron energies of .240 and .914 Mev. The reaction cross section appears to be isotropic in the center of mass coordinate system at deuteron energies of .260 and .455 Mev. At .978 Mev, the cross section at 120° is about 10% smaller than it is at 20°. Above .978 Mev, the angular dependance of the cross section becomes more pronounced, the cross section becoming smaller at high proton angles as the energy is increased. At a deuteron energy of 2.50 Mev, the cross section displays a minimum at approximately 113°. At 3.01 Mev, the minimum has shifted to 108°, and at 3.56 Mev, it appears at 103°. The total cross section is observed

to pass through a maximum at .430 ± .030 Mev. The value of the cross section at the maximum is 0.90 ± 0.10 x 10^{-24} cm^2. The probable error in the data is ± 5% at deuteron energies of .978 Mev and above. Below .978 Mev the probable error becomes progressively larger, due to the necessity of correcting the measured cross section for the effects of multiple scattering of the deuteron beam in the entrance window of the reaction chamber. The probable error has been estimated to be ± 11% at .455 Mev, and ± 25% at .260 Mev. The data below .978 Mev are not sufficiently accurate to permit a detailed fit with the one level dispersion formula. However, comparison of the maximum value of the cross section with the maximum possible cross section for a single level, together with the requirement that angular momentum and parity be conserved, indicate that the maximum in the reaction cross section is due to a $D_{3/2}$ state of the compound nucleus Li^5.

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PHYSICS, ELECTRONICS AND ELECTRICITY

THE ELECTRICAL PROPERTIES OF SELENIUM

(Publication No. 4933)

Herbert Walter Henkels, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: P. H. MILLER, JR.

The electrical properties of selenium have been examined by techniques of simultaneous thermoelectric power, and d.c. resistivity, as well as a.c. resistivity measurements. Both the liquid and the solid hexagonal forms have been studied. The influence of non metals O_2, S, I_2 and of metals Zn, Ni, Cd, Na, Ga, Hg, Ce, Fe, Pb, Ag, Cu, Te, Sb, Bi, Tl, Co, In, and Mg on the above properties has been determined. The crystallization process has also been studied and a qualitative correlation of electrical properties with microstructure has been found. Single crystals of selenium have been grown from the melt and tested together with selenium crystallized in various manners.

From the aggregate data a model of the selenium semiconductor has been developed. The forbidden bandwidth in the liquid and amorphous forms is 2.32 eV. Hole conduction predominates with a mobility of 900 cm^2/volt sec.

The most perfect crystallite of selenium examined has a hole concentration of less than $10^{+14}/cm^3$. The mobility parallel to the c-axis is from 5-17 cm^2/volt sec. at 40°C, and 35 cm^2/volt sec. at 180°C. Above 160°C the lattice defects decrease in number or their activation energies increase so that there is a decrease in number of carriers. This effect is attributed to the fact that the lattice is becoming more molecular.

Three types of energy levels have been discerned in solid hexagonal selenium. The first type is an acceptor level of low activation energy. The non metals form this kind of level. The concentrations of these vary from 1 x 10^{14} up to 6 x $10^{16}/cm^3$.

The second type of level (.27 eV above the full band) is associated with defects which are present in strained material or in incompletely recrystallized material. (Selenium first crystallizes in a colony structure then recrystallizes at higher temperatures to a metallic structure of equiaxed grains.) When the microstructure becomes equiaxed the density of these levels decreases rapidly. A large number of metals when alloyed with selenium in amounts to .1 atomic percent form a third type, a donor level.

The d.c. properties are determined principally by the behavior of potential barriers resulting from the segregation during crystallization of both metals and non metals in selenium. The most immediate result of adding impurities to selenium is the alteration of the balance between the acceptor and the donor levels at aggregation, probably at grain boundaries or dislocations.

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THE INVESTIGATION OF THE OXYGEN PRESSURE DEPENDENCE OF THE ELECTRICAL PROPERTIES OF SINTERED ZINC OXIDE AT HIGH TEMPERATURES

(Publication No. 4955)

Charles Frederick Wahlig, Jr., Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: P. H. MILLER, JR.

The electrical properties of sintered zinc oxide powder depend in a complicated manner on the past history of the sample. Recent investigations have strongly suggested that geometrical factors such as grain size and surface to volume ratio are primarily responsible for the observed electrical behavior. Hahn[1] and more recently Morrison[2] have applied high resistance grain boundary theories to well sintered high conductivity zinc oxide with success. These theories predict that the electrical conductivity may change radically with external oxygen pressure, temperature, incident light, or time while the Hall coefficient remains nearly constant, since it is purely a characteristic of the grains and not of the high resistance grain boundaries. Previous experimental evidence has shown this to be the case for well sintered low resistance samples.[2]

However simultaneous measurements of the conductivity and the Hall coefficient of zinc oxide that has been sintered for short lengths of time are reported here which appear to make the extension of

the high resistance grain boundary theory to this type of sample unwarranted. The external oxygen pressure, incident light, the temperature, and the time all have an effect upon the Hall coefficient of poorly sintered material.

On the basis of these measurements a supplementary theory is suggested which is applicable only to poorly sintered samples, but merges logically with the grain boundary theory as the sintering time is increased. The major assumption is the existence of non-uniform sintering action. Beneath a surface layer (10^{-6} cm. thick), which is depleted of effective interstitial zinc atom donors by the chemical absorption of oxygen gas at ordinary temperatures,[2] there exists a high conductivity layer rich in interstitial zinc. The time and temperature of sintering determines the depth of the diffusion of this interstitial zinc towards the center of each grain. In this way poorly sintered samples can be regarded as surface conductors of electrical current, since the high conductivity layer may be only a small fraction of the radius of the grains.

The consequences of this model are discussed and are shown to be in agreement with the observed variation of the Hali coefficient, grain size, and the AC impedance of poorly sintered samples as a function of the frequency. Measured mobilities of poorly sintered samples, well sintered samples, and single crystals are reviewed, and the spuriously low mobility of poorly sintered samples is explained in terms of the surface conduction model.

In addition the phenomenon of the disappearance of chemi-sorption centers with time first reported by Morrison is further illustrated by new conductivity measurements to be quantitatively correct.

1. E. E. Hahn, J. Appl. Phys. 22, 855 (1951).
2. S. R. Morrison, Tech. Report #4, Navy contract N6-onr-24914, University of Pennsylvania, (1952).

Microfilm copy of complete manuscript of 64 pages, $1.00. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-458.

PHYSICS, NUCLEAR

NEUTRON POLARIZATION

(Publication No. 4665)

Jerome Fleeman, Ph.D.
Stanford University, 1953

Introductory material on the polarization of a beam of slow neutrons is given in the first chapter. This is followed by a discussion of the experimental equipment used in the present experiment. Experiments for the determination of the polarization cross section p of iron with monochromatic and non-monochromatic neutrons are described. The absolute value of p as well as its dependence on the neutron velocity is found to be in good agreement with the recent calculations of Steinberger and Wick and with other experiments. For a complex neutron spectrum originating from a paraffin moderator $\bar{p}$ is found to be $(2.35 \pm 0.1) \times 10^{-24} cm^2$ in good agreement with previous investigations. It is shown that the larger value of $3.15 \times 10^{-24} cm^2$ found by Hughes, Wallace and Holtzman must be due to spectral differences. The approach of the magnetization of iron towards saturation is also investigated.

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PHYSIOLOGY

METABOLISM OF CARBON 13-LABELED SUBSTRATES AND KINETICS OF DEUTERIUM OXIDE EXCHANGE IN THE ISOLATED HEART

(Publication No. 4847)

Henry Mead Cavert, Ph.D.
University of Minnesota, 1952

1. A modification of the conventional Langendorff technique for perfusion of the isolated dog heart has been described. The chief advantages of this modification are (1) adequate oxygenation and more nearly physiological environment for cardiac muscle cells by perfusion with autogenous, heparinized blood at nearly physiological pressure, and (2) uninterrupted coronary blood flow by an appropriate sequence of procedures in cannulation and isolation of the heart preparation.

2. The isolated dog heart preparation has been utilized in an investigation of the metabolism of isotopically-labeled substrates by cardiac muscle.

   a. All 3 carbon atoms of sodium lactate are converted to respiratory CO_2 in appreciable quantities. In 8 experiments, a mean of 9.3 per cent of the collected CO_2 was derived from the carboxyl carbon of administered lactate-1-C^{13},

whereas a mean of 5.5 per cent of respiratory CO_2 was derived from the alpha or beta carbon of lactate-2,3-C^{13} added to 3 preparations. The difference in results from the two groups of experiments indicates that the carboxyl carbon of lactate is more readily converted to CO_2 than are the alpha and beta carbons. Possible explanations for this difference are offered.

b. When 2- and 3-carbon fatty acids were administered as the carboxyl-labeled sodium salts, approximately 35 and 15 per cent of respiratory CO_2, respectively, was derived from the administered substrate. This result confirms other work with respect to utilization of isotopic acetate by cardiac muscle and indicates that propionate is readily oxidized by the isolated heart.

c. Added sodium succinate-1,4-C^{13} contributed a maximum of 4 per cent of collected CO_2. Qualitative evidence was obtained confirming reports on the negative inotropic effect of sodium succinate on the isolated beating heart.

d. In no case were labeled carbon atoms from the administered substrates transferred to cardiac glycogen to an extent detectable by the analytical methods employed. A negative result with respect to glycogen labeling was likewise obtained when $C^{13}O_2$ was administered to the isolated dog heart. The discrepancy between these results and those reported by others from experiments on the isolated cat heart is discussed. At the present time, a metabolic species difference or an unknown critical difference between experimental techniques appear as possible explanations.

The inability of sodium lactate to contribute labeled carbon to glycogen was studied further. Experimental variations designed primarily to reduce dilution of isotopic cardiac glycogen by non-isotopic glycogen failed to alter the negative result. These variations included (1) experiments conducted on a "working" isolated heart preparation; (2) a ten-fold increase in the concentration of carboxyl C^{13}; (3) concomitant administration of glucose with or without insulin, and (4) pre-experimental cardioacceleration by periodic administration of adrenalin.

3. The isolated dog heart preparation and the isolated dog skeletal muscle preparation of Lifson were employed for a kinetic study of transcapillary exchange of deuterium-labeled water in perfused organs.

a. Over a wide range of blood water flows (ratio of mean blood water flow to organ water volume times 100 ranged from 2.2 to 19.5 per minute for skeletal muscle and from 29 to 89 per minute for the beating heart), flow rather than capillary permeability appears to limit the transcapillary exchange of water under these experimental conditions. Data from pooled experiments adhere closely to a theoretical curve derived on the assumption that flow is the rate-determining factor for transcapillary exchange. Other implicit assumptions are that the extravascular fluid is completely and rapidly mixed, and that a steady state with regard to water content exists in the perfused organ.

b. The data can also be interpreted to indicate that the time for equilibrium with respect to D_2O between plasma and red blood cells is less than the time required for blood to traverse the average capillary at the flow rates studied.

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THE ACTION OF HEPARIN ON FERTILIZATION AND CLEAVAGE

(Publication No. 4924)

André Joseph Lucien Gagnon, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: L. V. HEILBRUNN

A study was made of the action of heparin (from Hynson, Westcott, and Dunning Co.) on fertilization and cleavage in the eggs of the sea urchin, Arbacia punctulata, the surf clam, Spisula solidissima, and the frog, Rana pipiens. The following results were obtained with a 0.2% heparin solution (0.2 gram/100 cc. of solution).

1. Insemination of the eggs of Arbacia and Spisula, in the presence of a heparin solution, causes a high percentage of cleavage inhibition. This conclusion also applies to the eggs of Rana, although the inhibition is much less pronounced. Under those conditions, the length of the exposures to heparin, before insemination, does not affect the degree of inhibition.

2. Transfer, to the normal medium, of the eggs inseminated in the presence of heparin, is accompanied by an increase of the percentage of cleavage. This increase is very large in the case of the marine eggs, and the percentage of cleavage usually reaches a value quite similar to that of the control eggs. On the other hand, this increase is relatively small in the case of the frog eggs, and it only occurs when the transfer is made very shortly after insemination. Anyhow, the percentage of cleavage does not generally attain that of the control eggs. This is taken as an indication that the action of heparin, on the marine eggs, is reversible, while it is not, on the frog eggs. In the Spisula eggs, the transfer is accompanied by an increase in the percentage of germinal vesicles broken down. It is concluded that fertilization occurs after the transfer to the normal medium.

3. Heparin prevents the formation of a normal fertilization membrane in the eggs of Arbacia inseminated in its presence. Under similar conditions, it prevents, in some of the frog eggs, the rotation which normally occurs within about 20 to 30 minutes after fertilization. In Spisula, eggs inseminated and

left in the heparin solution are characterized by low percentages of germinal vesicles broken down. These low percentages indicate an absence of fertilization. These data indicate that heparin can prevent cleavage by inhibiting normal fertilization.

4. Normally fertilized eggs exposed to a 0.2% heparin solution continue to cleave.

5. However, heparin causes cleavage delay in the eggs of Spisula indicating that the egg membranes are permeable to heparin. No cleavage delay was observed in the eggs of Arbacia and Rana.

Some possible explanations are offered to account for the different results obtained by other workers on the cells of different species. Moreover, a correlation is made between these results and those obtained by other workers using heparin-like substances.

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A STUDY OF THE LIBERATION OF ORTHOPHOSPHATE FROM ADENOSINE TRIPHOSPHATE BY THE STROMATA OF HUMAN ERYTHROCYTES

(Publication No. 4934)

Edward Herbert, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: M. H. JACOBS

The ability of freshly prepared, well washed stromata of human erythrocytes to liberate orthophosphate from solutions of adenosine triphosphate (ATP) has been studied under standard conditions. With ATP concentrations between 0.45mM/L and 1.2 mM/L in a medium containing 6×10^{-3} M/L $MgCl_2$, at a pH of about 7.0, and a temperature of 35°C, the average amount of orthophosphate liberated by a single stroma in one minute is 5×10^{-10} gamma.

To secure reproducible results with stromata it is necessary in their preparation to avoid the irreversible agglutination and the inactivation of the enzyme system that result from the common method of acid precipitation.

The activity of stromata is not decreased by 5 washings in distilled water; if anything it is somewhat increased.

No dephosphorylating effect has been found in the stroma-free hemolysates.

The activity of an intact well-washed erythrocyte is only half that of its stroma with respect to ATP in the external medium.

The agent responsible for the activity of the stromata has all the usual characteristics of an enzyme.

There is a direct proportionality between the concentration of the stroma enzyme and its initial rate of dephosphorylation of an ATP solution.

The effect of substrate concentration agrees with predictions from the equation of Michaelis and Menten. The Michaelis constant has a numerical value of 2.4×10^{-4}.

Human stromata dephosphorylate ADP (adenosine diphosphate) and ATP at approximately the same rate. Na pyrophosphate is decomposed at a lower but significant rate. They have little effect on fructose 6 - phosphate, phosphoglyceric acid, beta - glycerophosphate, and muscle adenylic acid.

Experiments with pairs of substrates, singly and in combination, suggest that different enzymes are involved in the breakdown of ADP and ATP on the one hand, and Na pyrophosphate on the other. The dephosphorylation of ADP and ATP appears to be governed by a single enzyme.

The activity of stromata is enormously increased by Mg ions, the optimum concentration being about 7×10^{-4} M/L.

Ca is also a potent activator, but its effective concentration range is much higher than that for Mg.

Ca ions antagonize the effect of Mg ions. The important factor in this antagonism is not the absolute amount of Ca but the Ca:Mg ratio. This finding suggests a process of competitive inhibition.

In good agreement with the results reported by Clarkson and Maizels, the pH of optimum stability of the enzyme system here has been found to be 7.0 - 7.5.

Stroma apyrase undergoes inactivation at high temperatures in a manner that is typical of enzymes in general. Considerable protection is furnished by the presence of the substrate, ATP.

Stroma apyrase is likewise inactivated by copper, iodoacetate, and Na fluoride. The concentration of each of these at which 50% inactivation occurs in 30 minutes is: 2×10^{-1} M for iodoacetate, 6.3×10^{-4} M for Na fluoride, 1×10^{-4} M for copper with stromata, and 1×10^{-5} M for copper with intact cells.

Intact erythrocytes are more readily inactivated by a given amount of copper than are the same number of stromata but reversal of the effect is likewise more readily produced by the addition of either cysteine or a small amount of stroma-free hemolysate from intact erythrocytes. These and other results suggest that sulfhydryl groups are involved in the activity of the enzyme system and that in the intact erythrocyte any enzyme molecules having an effect on ATP in an external solution are located at the outer surface of the cell.

The deterioration of the enzyme system with age involves at least two different processes: one which progresses for a time without any change in the favorable effects of added cysteine, and the second, later one involving the loss of the cysteine effect itself.

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FACTORS AFFECTING CORTICAL AND SUBCORTICAL RESPONSES TO PHOTIC STIMULATION IN THE CAT

(Publication No. 4860)

Donald Arthur Johnson, Ph.D.
University of Minnesota, 1952

Seventy cats were used in experiments aimed at elucidating the pathways of the photomyoclonic response (Gastaut) by means of: (1) latency measurements at the optic nerve lateral geniculate cortex and muscle, and (2) acute and chronic excision of striate cortex and cerebellum.

By increasing the depth of pentothal anesthesia (measured by the integrator) the striate latency could be lengthened from 13 to 36 milliseconds. Metrazol reversed this barbiturate effect. Latency was inversely related to light intensity at all levels of anesthesia. The latency is lengthened by asphyxia but is relatively insensitive to blood pressure change. The findings suggest the need for caution in the interpretation in the latency changes under the complex conditions of the photometrazol test.

Contrary to the results of Gastaut and Hunter acute and chronic bilateral excision of the striate cortex did not eliminate the irradiated frontal or the myoclonic response. In preparations free from shock post-excision frontal and myoclonic latencies were unchanged. Acute excision of the cerebellum was not found to change the myoclonic response.

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CYCLIC VARIATIONS IN THYROID FUNCTION OF MATURE FEMALE RATS AND MICE

(Publication No. 4701)

Fouad Atalla Soliman, Ph.D.
Michigan State College, 1952

A series of experiments was performed to determine some of the factors involved in the hormonal balance of the thyroid, pituitary, and ovary.

1. Determinations were made of oxygen consumption body temperature and body weights of rats under basal conditions during the four stages of the estrous cycle. It was found that there is a significantly increased oxygen consumption during estrus. There were no significant differences between basal temperatures or body weights at the four states of the estrous cycle.

2. The study of radioiodine uptake by the thyroid glands of rats during the estrous cycle showed that there is a significantly increased uptake during estrus. The uptake gradually decreases at metestrus and attains its lowest level during diestrus and proestrus.

3. Similar studies of radioiodine uptake by the thyroid glands of mice during the estrous cycle showed a pattern of cyclic variation different from that of the rat. The maximal uptake of radioiodine is attained by the thyroids of proestrous mice.

4. A single injection of six or 300 rat-units of estradiol benzoate increased the six-hour uptake of radioiodine forty-eight hours after the estrogen injection. There were no differences between the effects of the two doses on thyroid uptake, with the conclusion that the dose of estrogen is not very critical.

5. The prolonged administration of a large dose of estrogen did not change the radioiodine uptake by the thyroids when compared to controls.

6. A single dose of 0.2 or 0.4 milligram of progesterone decreased the uptake of radioiodine by the thyroids while a dose of 0.8 milligram increased the uptake.

7. The injection of 0.4 milligram of progesterone counteracted the effect of estrogen on thyroid function with the net result of a decreased radioiodine uptake.

8. Experiments with hypophysectomized-ovariectomized rats showed that estrogen produces its stimulating effect on the thyroid gland via the pituitary gland since it did not change the radioiodine uptake in such animals.

9. Progesterone decreased the uptake of radioiodine by the thyroid glands of hypophysectomized rats showing that it does not induce its effect mainly via the pituitary.

10. The thyrotrophic hormone potency of the pituitaries of estrous rats is slightly higher than that of rats at the other stages of the estrous cycle. The thyrotrophic hormone content of the blood serum of estrous rats exceeds slightly that of rats at the other three stages of the cycle.

The results of the present investigations together with information reported earlier, established clearly the fact that there is a reciprocal balance between the hormones of the thyroid gland and the ovary. This balance is mediated in part via the pituitary and in part via other pathways.

In experimental animals hypothyroidism favors the production of follicle stimulating hormone while, hyperthyroidism favors the productions of lutenizing hormone. In the rat the thyroid gland is more active prior to and during ovulation. It becomes less active during the luteal development and also during the graafian follicle development.

Such cyclic variation of thyroid activity is controlled by the ovarian hormones. Estrogen activates it via the pituitary, while progesterone depresses it through other pathways than the pituitary.

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POLITICAL SCIENCE, GENERAL

THE CONSTITUTIONAL PROBLEMS OF NATIONAL CONTROL OF THE SUFFRAGE IN THE UNITED STATES

(Publication No. 4849)

Janice Evelyn Christensen, Ph.D.
University of Minnesota, 1952

National control of the suffrage in the United States raises numerous constitutional problems. The problems derive essentially from the fact that the national government has unusually limited suffrage powers under the Constitution in contrast to broad state suffrage powers. The Constitution expressly grants the national government suffrage power in only three provisions, Section 2 of the Fourteenth Amendment, the Fifteenth Amendment, and the Nineteenth Amendment. These provisions do not empower the national government to confer the suffrage in elections of its own or state officers. The Constitution recognizes state power to prescribe the voting qualifications that are adopted by the Constitution for voters who elect members of Congress. The Constitution also grants to the states the power to select Presidential electors, and this power has been employed by the states to confer upon voters the right to choose Presidential electors. Furthermore, the states have power over the suffrage under their reserved powers.

Most constitutional problems of national suffrage control have concerned three subjects: (1) national control of Negro suffrage; (2) national anti-poll tax bills; and (3) national control of soldier voting. Recent developments affecting these subjects reveal a growing national suffrage power.

The constitutional problems of national control of Negro suffrage concern the scope of Congressional and state suffrage power after the passage of the Fifteenth Amendment. An analysis of these problems discloses that Congress has power by the Fifteenth Amendment to prevent only governmental action that would result in racial discrimination in voting. Congress has no power to confer the right to vote, to prohibit improper acts not based on race, or to act against private individuals or groups. The analysis discloses also that although the Fifteenth Amendment prohibits state-imposed racial discrimination in voting, it does not destroy state power to intiiate suffrage measures. This power of initiation has permitted some state measures that in effect exclude Negroes. However, in comparatively recent cases, the courts have prohibited racial discrimination resulting from (1) state provisions classifying voters on a pre-Fifteenth Amendment basis; (2) state provisions conferring arbitrary power upon election officials; (3) state administrative discrimination; and (4) the white primary, irrespective of state regulation.

Constitutional problems of the suffrage arising from national anti-poll tax bills and national soldier vote bills are basically similar in that they concern national power to regulate voting conditions not based on race or sex in national elections. An analysis of these problems shows that the national government has power to regulate to some extent these voting conditions and that largely for this reason the national anti-poll tax bills and the suffrage provisions of the soldier vote measures are constitutional.

National suffrage power over voting conditions not based on race or sex in national elections may be traced to several sources, including Congressional power to regulate the times, places, and manner of holding Congressional elections because this power is plenary and the suffrage and election regulations cannot be rigidly separated. Power may also be traced to the "equal protection of the laws" clause, the "republican form of government" clause, and to powers to secure the proper functioning of Congress and to enforce the popular choice for members of Congress. Notwithstanding broad state power to choose Presidential electors, national power in Presidential elections over voting conditions not based on race or sex may be traced to national power to safeguard from impurities the selection of the President and to enforce various constitutional clauses like the "equal protection of the laws" clause. Doubt surrounds, however, national power to enforce a constitutional right to vote for Presidential electors or to regulate the manner of holding Presidential elections. Finally, national suffrage power may probably be traced to the war powers because soldier voting may affect the war effort.

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THE THIRD FORCE IN FRENCH POLITICS

(Publication No. 4674)

Francis Paul King, Ph.D.
Stanford University, 1953

Throughout the years of German occupation of France expressions of hope for a new political life for France were almost universal. Some ideas favored a broad new labor movement to replace a number of the prewar parties. Others favored using the resistance organizations as a nucleus for a great new political party. But although considerable political changes were predicted and desired, the recovery of the major political parties during the resistance period through clandestine reorganization, resistance participation, and internal purges, prepared those parties for renewed activity along their traditional lines once the occupiers had been driven out. This period reveals that the development of ideas producing the Third Force of 1947-1948 came not from plans for new political forces, but rather from more immediate developments of the year 1947,

after the Fourth Republic had been inaugurated. These events began with the withdrawal of the Communists from the Ramadier government in May 1947 and reached their climax with the October 1947 RPF election victories and the general strike of November -December.

The first years of the Fourth Republic brought into use the term "Third Force" to describe the democratic and republican political parties which were opposed to Gaullist forces on their right and Communist forces on their left. This Third Force represented a shared political ideal, though traditional party differences were stoutly maintained, and an effort at inter-pary cooperation designed to diminish the strength of the dual opposition. Particularly after the year 1948 the term Third Force was used as a general designation of left-of-center parties maintaining faith in parliamentarism, pluralism, and democratic republicanism, the "vital center" of French politics steering a course between neo-fascism and communism.

This study deals with the origin of the Third Force in domestic French politics, when the term was applied to a specific political situation and when the "force" itself was conceived and constructed as an inter-party liaison body, in which were represented Popular Republicans, Socialists, the UDSR, Radical Socialists, the Jeune République, and trade unions. This executive committee put into practice ideas first suggested by Léon Blum and Guy Mollet before the National Assembly following the victory of the Gaullist RPF in the municipal elections of October 1947. Blum envisioned the establishment of a union of republicans who were to reinforce the threatened governmental majority, move the democratic political parties to closer cooperation, and build up the expression of a Third Force ideology which would end the negativism which characterized republican opposition to extreme right and left.

The Executive Bureau of the Third Force established an office in Paris in January 1948 and met weekly until July 1948, when the collapse of the Schuman government terminated the organization. The goal of the Third Force was to build up a living democratic spirit in France, develop a new spirit of inter-party cooperation, and support the Schuman government. The means to these ends were the creation of provincial Third Force committees, full discussion of political issues at the weekly executive meetings, and attempts to minimize differences between member parties and organizations. Most of the contemporary issues were capable of resolution. However, those arising out of the Poinso-Chapuis decree of May 22, 1948, and the military credits issue of July 1948 created a climate in which, in view of the fall of the first Third Force government, it was not possible to continue the work of the Third Force organization. Its legacy was in its purpose and name, in the experience of organized inter-party cooperation, and in the aid given democratic government through the most trying period of the Fourth Republic's existence.

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POLITICAL SCIENCE, PUBLIC ADMINISTRATION

INTERJURISDICTIONAL AGREEMENTS AS AN INTEGRATING DEVICE IN METROPOLITAN PHILADELPHIA

(Publication No. 4914)

Jeptha Jefferson Carrell, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: J. C. PHILLIPS

This is a study of one of several alternative devices for solution of the metropolitan problem of integration. The physical scope encompasses the Philadelphia Metropolitan District as defined for the 1950 census (eight entire counties). Jurisdictions studied include cities, townships, boroughs, school districts, "authorities," and the eight county governments, - a total of 686 units of government. Responses were received from approximately ninety percent of these units.

Chapter I, "Nature and Purpose of Interjurisdictional Agreements" deals with the need for integration, methods of integration, and the Los Angeles experience with interjurisdictional agreements.

Chapter II, outlines the legal basis for interjurisdictional agreements in Pennsylvania and New Jersey.

"The Interjurisdictional Agreement as an Integrating Device in the Public Works and Utility Fields," Chapter III, describes, tallies, and analyzes the various types of agreements found in these fields. There are 59 sanitary sewage agreements involving 66 municipalities or 19.5% of all municipalities with power to act in this field. Other totals show 4 agreements in water supply, 102 in road construction and maintenance, 51 in bridge construction and maintenance, and 2 in the field of transportation. The bulk of these agreements have arisen since the middle 1930's.

Chapter IV, "The Interjurisdictional Agreement as an Integrating Device in the Field of Protection to Persons and Property," shows that there are 138 such agreements. Of these, 101 concern police radio communications, 31 deal with traffic lights, and 2 with other police functions; 3 are in the field of health service; and one agreement is for the disposal of trash. Fire protection is a function discharged by non-governmental agencies in nearly all municipalities.

Chapter V concerns "Interjurisdictional Agreements Involving School Districts." A total of 124 districts (out of 339) are signatories to joint school

agreements (a single school for certain grades) involving from two to eight districts. Joint school agreements, along with a number of less prevalent varieties of school agreements brings the total of agreements in the field of education to 389.

Chapter VI is a discussion of agreements which do not fall within the province of other chapters. Some of these concern recreation, airports, joint purchasing and zoning. Only a handful of agreements were found in these fields.

"Conclusions and Recommendations" are given in Chapter VII. The most significant conclusions are, in brief:

1. For the Philadelphia area the most practicable devices for integration are grants-in-aid, federation, and interjurisdictional agreements.
2. There are 756 agreements in functional fields in 427 jurisdictions (including all 8 counties, 218 cities, townships and boroughs, 200 school districts and one authority).
3. Sixty-four percent of the cities, townships and boroughs, and 59% of the school districts are parties to one or more agreements.
4. Functional integration has been achieved on a limited scale with greatest frequency in four main fields: sewage, road and bridge construction and maintenance, education, and police protection.
5. The record of achieved integration is a modest one when related to the total problem. Of a total of 678 local governments (counties not included in this figure) the greatest single group of participants is 49 (police radio) and most of the significant agreements involve no more than three or four parties.

Recommendations:

1. Pennsylvania statutes be amended to provide all local jurisdictions with a general power to enter into interjurisdictional agreements.
2. A concerted effort be made to acquaint the people with the possibilities for providing more effective common services at a saving through use of interjurisdictional agreements.
3. Use of other integrating devices, especially federation and grants-in-aid be not abandoned, even though the most useful and popular device for securing integration is the interjurisdictional agreement.

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PSYCHOLOGY, GENERAL

THE GENERALIZED DISTANCE FUNCTION AND DIFFERENTIAL APTITUDE TESTING

(Publication No. 4843)

John Richard Boulger, Ph.D.
University of Minnesota, 1952

Much research has been undertaken with the United States Employment Service's (USES) General Aptitude Test Battery (GATB), but none of it has been specifically designed to test the hypothesis underlying their program: that occupational groups can be differentiated with their tests. Recently it has been suggested that psychologists turn their attention away from the question of employee selection to the problem of classification. With the development of R. A. Fisher's linear discriminant function and generalizations of it, the statistical technique both for the testing of the hypothesis and for the classifying of employees is now available.

Three groups of workers — knitting mill workers, tabulating machine operators and hand decorators in a pottery plant — were tested with the GATB, and Mahalanobis' Generalized Distance Function, D^2, was used to test the hypothesis that workers in the three occupations could be differentiated on the basis of their GATB scores.

To provide an estimate of the effectiveness of the technique and the battery, the sample of workers in each occupation was randomly divided into two subsamples and a double-cross-validation design used.

Following the method of Rao, discriminant coefficients were determined separately for each subsample, and then applied back on both subsamples. The efficiency of classification was tested by comparing the predicted occupation with the actual occupation for each worker in the subsamples.

In each subsample, using either the discriminant coefficients obtained in the validation or in the cross-validation subsample, classification was significantly better than chance. Prediction of occupation using the cross-validation weights was only slightly less effective than that using the validation weights (58% and 62%, respectively).

There were greater similarities in the classifications of the three occupational groups made in the two different subsamples with one set of discriminant weights than there were in applying different sets of weights to one subsample.

Although there was a slight nonsignificant difference between percentages of correct predictions for the three groups as a whole using the two sets of weights (validation and cross-validation), there were large differences in the percentages of correct classifications of two of the occupational groups

(hand decorators and tabulating operators) with the two sets of weights. The results indicate that weights which give minimum misclassifications might not be the weights that a person using the technique in a practical situation might wish to use.

According to Rao, if it is known that an individual does not belong to a certain group she can be assigned to one of the other groups considering only her linear discriminant scores. This was done for all pairs of groups.

Again, classification was significantly better than chance. The percentage of correct classifications varied between 67 per cent and 81 per cent. The most effective discrimination was between tabulating operators and hand decorators. Using the cross-validation weights, the classifications were only slightly less effective than those made using validation weights.

The thesis contains tables of intercorrelations of the aptitudes computed for each of the subsamples, figures showing the method of computing D^2 and the discriminant coefficients, and examples of the method of computing Rao's statistical criterion to determine the group to which an individual belongs, job descriptions for the three occupations studied, descriptions and illustrations of the subtests and aptitudes of the GATB as well as the first published information about the reliability coefficients of the aptitudes of the battery. The latter are published with the permission of the USES whose affiliated agencies conducted the studies.

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STUDIES IN MOTIVATION AND CONFLICT IN THE RAT

(Publication No. 4846)

Alexander Miller Buchwald, Ph.D.
University of Minnesota, 1952

(1) The postulates of conflict-theory were stated in what is believed to be their broadest and most explicit form to date. Briefly these postulates are:
I.* The excitatory-potential of approaching behavior, for a suitably motivated organism, is some decreasing function of the distance of the organism from the goal.
II. The excitatory-potential of avoidance behavior, for an organism confronted with a suitable fear-elicitor, is some decreasing function of the distance between the organism and the fear-elicitor.
III. Gradients in the strength of excitatory potentials for avoidance behavior are steeper than gradients in the strength of excitatory potentials for approach behavior.
IV. The overall height of gradients of excitatory potential, either for approach or avoidance behavior, vary directly as a function of the drive upon which they are based.
V. When the excitatory-potentials for two incompatible responses are simultaneously present, the ensuing response will be the one which has the momentarily greater excitatory potential associated with it.

(2) A review of the literature disclosed that a fair amount of direct experimental evidence exists for the first three postulates.

(3) Under the assumptions that: greater force exerted in an attempt to make a learned response is indicative of greater excitatory potential; a longer period of food deprivation or a greater electric shock current value represents an increase in drive; and, that the strength of fear is a direct function of increase in noxious stimulation which an animal has experienced, three experiments were designed and executed with white rats as subjects. The results indicate that: (a) Animals trained under 23 hours of food deprivation behave in accordance with postulate I. Animals trained under 6 hours do not. (b) Animals trained under both 6 and 23 hours of food deprivation behave in accordance with postulate IV. (c) Animals trained in an escape response using both .2 ma and .6 ma of electric current behave in accordance with postulate IV. (d) Animals trained to avoid the lighted end of an alley, using .2 ma or .6 ma of electric current respond in accordance with postulate II. (e) Animals trained to avoid the lighted end of an alley using .6 ma of electric current do not pull harder than animals so trained using .2 ma of current. (f) Animals trained in an avoidance response show a steeper gradient of response strength than do animals trained in an escape response.

*A definition of terms used is presented together with the original presentation of these postulates.

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THE VALUE OF PERSONALITY ADJUSTMENT QUESTIONNAIRE ITEMS IN THE PREDICTION OF OUTCOMES IN COLLEGE ENGINEERING TRAINING

(Publication No. 4850)

William Ramsden Crooks, Ph.D.
University of Minnesota, 1952

Purpose

To determine whether there are certain self-concepts, as revealed by responses to personality adjustment questionnaire items which differentiate between high and low achieving first-term college engineering students and whether such concepts can be combined into a scale yielding scores related to first-term grades.

Methodology

A questionnaire was administered to 131 freshman

engineering students entering Oregon State College September, 1950. The questionnaire contained questions about the subject, such as educational and family background, etc.; forty multiple choice items regarding family relationships, previous experience, etc.; and 844 statements taken from various published adjustment inventories and with which the subject was asked to agree or disagree as regards to his behavior and attitudes.

Since first-term grades were employed as the criterion for the analysis of subjects' responses, Wilks' Method A was employed to maximize the variations in grades found to exist among the various courses. Further, Hoyt's analysis of variance method was used to determine the reliability of grades, which was found to be .72.

The questionnaire item responses were analyzed against first-term grades using Mosier and Katzell's double cross-validation method. This consisted of splitting the original sample into two parts and making two independent item analyses, using a Chi-Square method. From these analyses two scales resulted composed of items found to differentiate significantly between the extreme 27 percents of each of the two groups. Each scale was cross validated by scoring the questionnaires of each group with the scale developed by the item analysis of the other group and correlating the scores against grades. As a final step, when the items of the two scales were combined into a composite scale, the scores of the composite scale were correlated with first-term grades.

As a subsidiary problem, correlations of the various admissions data and first-term grades were calculated to discover, by means of multiple correlation, a battery of measures which would yield the highest possible predictive coefficient. Batteries for the prediction of subsequent college terms were also worked out on the same basis.

Results

In the cross validation step, the two scales resulting from the original item analyses correlated .24 and .37 with first-term grades for the groups on which the scales had not been item analyzed. When these scales were combined into a single composite scale and the scale refined, the final scale of 94 items correlated .55 with first-term grades.

The most effective battery, with a multiple correlation of .65 with first-term grades, developed from the various admissions data for predicting first-term grades was composed of the C_3 test (the study scale), the OSC arithmetic placement test and the high school science grades. In the prediction of second term grades only the C_3 and high school science grades were found to have significant beta values when combined into a multiple regression equation; the multiple correlation was .70. When third-term and first year predictive batteries were attempted, it was found that none of the beta values were significant thus resulting in an elimination of all of the variables in the multiple regression equations.

Suggested Future Research

The study suggested the following avenues of further investigation:

(a) Validation of the study questionnaire upon other freshman engineering groups;
(b) Investigation of this type of measurement in relation to student performance in non-engineering curricula;
(c) Studies of the relationship of academic performance to results of other means of personality measurement;
(d) Development of adjustment items of the subtle type; and
(e) Investigation of pattern scoring of adjustment type instruments based upon the inter-relationships existing among items.

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AN EXPLORATORY INVESTIGATION OF THE HATHAWAY-MEEHL METHOD OF MINNESOTA MULTIPHASIC PERSONALITY INVENTORY PROFILE ANALYSIS WITH PSYCHIATRIC CLINICAL DATA

(Publication No. 4853)

Harold Gilberstadt, Ph.D.
University of Minnesota, 1952

1. The purposes of the investigation were (1) to present a description, and the results, of an application of the Hathaway-Meehl method of profile analysis and (2) to test the results of the analysis in terms of psychiatric clinical data and to apply these results to the interpretation of any profile configurations resulting from the analysis.

2. The MMPI profiles of a representative group of 100 male, psychiatric patients from the Fort Snelling Veteran's Administration Hospital were analyzed by the Hathaway-Meehl method. The resulting criterion profile which, it was proposed, contained the salient features which contribute patterning to the sample, was of the 27813*456"9 code type.

3. Sixty-two cases from the above population were selected on the basis of high similarity to the criterion profile type and compared to a group of 93 cases from the same population which were considered to be representative of cases not of the criterion profile type.

4. Comparison of the two groups suggested that no significant differences existed with respect to age, intelligence, education or occupational level. A significant difference was suggested with respect to marital status. Comparison of the mean MMPI profiles of the two groups suggested that the selected group was significantly more elevated on all of the variables and, in addition, had an increased emphasis on the Sc and SI variables.

5. The procedure employing psychiatric clinical data consisted of three parts:

(a) An analysis of the diagnoses suggested a trend for more of the selected group to be diagnosed depressive reaction but it was concluded that the diagnostic system had serious faults which should preclude any generalization based on straight statistical comparisons. An inspection of the anxiety reaction descriptive diagnoses and the paranoid schizophrenic causes for admission suggested that the selected group tended to be more consistently called severely anxious and depressed with paranoid and schizoid trends although not psychotic in a bizarre fashion while cases not of the selected type tended more often to be characterized as immature, psychopathic, alcoholic and possibly more bizarre when diagnosed paranoid schizophrenic.

(b) A check list study employing psychiatric discharge summaries appeared to be limited by the weaknesses of the discharge summaries for such analysis but yielded 11 significant items. Ten items were more frequent for the selected group and appeared consistent with the anxiety-depression-paranoid-schizoid syndrome. One item, evasive-defensive, was more frequent for cases not of the selected group.

(c) A matching study using the discharge summaries appeared to be subject to the same faults of the data as the above procedures but appeared to be the most favorable way of using such data. It showed better than chance reliability among five judges matching 10 discharge summaries to a personality description written from four other summaries. There appeared to be strong agreement between the rankings by judges and rankings by the CC index of profile similarity for these cases.

6. The method was generally compared with factor analysis and appeared to be less based on complex theorems and assumptions, less directed toward the discovery of basic source traits but rather aiming toward the identification of useful, meaningful modalities of surface traits, and, in addition, perhaps better suited to the aims of the clinic than factor analysis.

7. It was suggested that future research should: (a) Attempt to employ behavior ratings as a substitute for psychiatric clinical data; (b) Should try to find further types of profile configuartions; (c) Should extend the method to permit the investigation of low profiles; (d) Should extend the method to profiles in addition to those obtained from the MMPI.

In conclusion, it would appear that the method has sufficient promise to justify considerable extended research.

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INTER-RELATIONS OF PATTERNS ON THE KUDER PREFERENCE RECORD AND THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY

(Publication No. 4857)

Lindsey Richard Harmon, Ph.D.
University of Minnesota, 1952

Background

Pattern on psychological tests has concerned psychologists from earliest efforts at measurement. Patterns on tests of interests and personality have recently attracted increased attention. Data regarding the significance and inter-relations of such patterns are meagre. There is a need for quantitative studies to guide interpretations of test patterns as found clinically.

Purpose

To furnish information regarding the statistical and practical significance of inter-relations of patterns on the Kuder Preference Record and the Minnesota Multiphasic Personality Inventory. This general purpose is elaborated in a series of research problems which are outlined, and the answers to these problems are sought in this study.

Method

A procedure for coding patterns is developed, and the inter-relations of these codes on the KPR and MMPI are studied by means of chi-squared, for all patterns occurring with sufficient frequency to warrant application of this statistical test. A means of quantitatively evaluating the practical as well as the statistical significance of pattern relations is developed.

Population

2887 veterans undertaking vocational counseling in VA guidance centers in the Twin Cities, during a period when the great majority of veterans were given both tests, constitutes the population studied. Veterans with neuropsychiatric diagnoses were excluded from the sample, as were also those whose tests provide internal evidence of questionable reliability. Age and grade distribution of the cases retained are provided for more exact description of the group.

Results

Tabulations of the joint occurrence of each possible pattern on KPR and MMPI (within specified frequency of occurrence) are provided. Tables comparing theoretical and observed frequencies for such joint occurrence are presented, together with the probability of X^2 for each such event. Verbal interpretation of these tables gives a descriptive summary of the inter-relations of each group of patterns. Additionally, comparison of empirically observed relationships is made with the beliefs of counselors (as found in a minor companion study) regarding such relationships.

Conclusions

Results are compared with the specific objectives of the research. Significance of results is assessed, and findings here are compared with other studies in this area. Theoretical problems touching on, but beyond the scope of this study are described, together with suggestions for research design which may provide the answers to these problems.

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A COMPARISON OF CLINICAL AND ACTUARIAL METHODS OF PREDICTION WITH AN ASSESSMENT OF THE RELATIVE ACCURACY OF DIFFERENT CLINICIANS

(Publication No. 4866)

Richard Stanley Melton, Ph.D.
University of Minnesota, 1952

The relative accuracy of clinical and actuarial predictions of human behavior is a problem of both practical and theoretical significance. From a practical viewpoint, it is important to ascertain that most efficient method of prediction; theoretically it is important to evaluate the validity of human judgment and of the clinical method. Allport has argued strongly for the idiographic approach in psychology, and he has indicated doubts about the ultimate efficacy of actuarial (i.e. nomothetic) methodology.

A review of the literature revealed that few rigorous comparisons have been made, and that only four classes of behavior have been subjected to scrutiny, namely success in training or schooling, success on parole, institutional adjustment, and prognosis of psychotic patients. In those studies with reasonably adequate controls actuarial methods of prediction usually proved superior, but the comparison needs to be replicated with widely differing classes of behavior, subjects, and groups of clinicians.

This investigation involved several groups of counselors and personnel workers at the University of Minnesota making predictions of the academic success of several types of students entering the College of Science, Literature, and the Arts. The following hypotheses were tested:

1) There is no difference between the accuracy of clinical and actuarial predictions.
   Results: Hypothesis rejected; actuarial predictions (based on a two variable multiple regression equation) proved significantly more accurate. Even when one group of counselors knew the actuarial predictions before they made their clinical predictions, their accuracy was lower than that of the actuarial table.
2) Counselors who are allowed to use an actuarial table when making their clinical predictions are no more accurate than counselors who have no such information.
   Results: Because random selection of the experimental and control groups had resulted in an experimental group of inferior ability (as measured by the accuracy of earlier predictions), the only possible test of this hypothesis was to determine whether use of the actuarial table improved the accuracy of the experimental counselors. This was found to be the case although the improvement in accuracy could not be considered statistically significant.
3) There are no differences among counselors in ability to make accurate clinical predictions.
   Results: In one out of three experiments there were significant differences among counselors. The homogeneity of the counselors in the other two experiments may possibly be attributed to greater experience and training.
4) There is no difference between experienced and inexperienced counselors in ability to make accurate clinical predictions.
   Results: Experienced counselors were found to be more accurate, but not significantly so.
5) There is no difference between counselors trained in psychology and those trained in other fields in ability to make accurate clinical predictions.
   Results: Counselors trained in psychology were found to be slightly but not significantly more accurate.
6) Ability to make accurate clinical predictions is not affected by the amount of data the predictor has at his disposal.
   Results: In an experiment where the amount of data presented to the predictors was varied, the addition of a complete transcript of previous academic work resulted in a significant increase in accuracy. Knowledge of the courses the subjects were enrolled in did not aid the counselors to make more accurate predictions.
7) Clinical predictions of academic success are as often under-estimates as over-estimates
   Results: Hypothesis rejected; clinical predictions were found to be more often over-estimates than under-estimates (the error of leniency).

These hypotheses and others need to be tested on other populations of predictors, predictees, and classes of behavior. One, relating to the possibility of evaluating human judgment by means of the clinical prediction technique seems especially promising. However, it seems likely that given reasonably good measuring instruments and reasonably

quantifiable behavior to predict, actuarial predictions will prove to be as good as or better than clinical predictions.

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HEIGHT-WIDTH PROPORTION AND STROKE-WIDTH IN NUMERAL VISIBILITY

(Publication No. 4882)

Robert Stephen Soar, Ph.D.
University of Minnesota, 1952

The effect of simultaneous variation of two variables on numeral visibility was studied. One variable was height-width proportion with rectangular area of the digit held constant, the other was stroke-width.

The experimental numerals were drawn large, by hand, and reduced photographically. The resulting height-width dimensions (in inches) were: .1313 by .0396, .1067 by .0483, .0934 by .0558 and .0834 by .0625. The stroke-widths were .0083, .0125, and .0167 inches.

The subjects were volunteers from the elementary psychology laboratory at the University of Minnesota.

The presentations were made tachistoscopically for 40 milliseconds under one foot candle of illumination. These values were determined by a pilot study to be most likely to result in normal error distributions.

In the main experiment, there were six replications for each of 12 combinations of experimental conditions, using a total of 72 subjects. Each subject was given 30 exposures of practice material, standard for all subjects, then 90 exposures of the experimental material.

Analysis was by analysis of variance and covariance, with the data from the practice period used to adjust the experimental sums of squares for individual differences. The results for each numeral were analyzed separately. The assumptions of homogeneity of variances and normality of distribution were examined by probit analysis. The assumptions appeared to be satisfied for all data except the 0 and 8, and separate analyses were carried out for the portion of the data which did appear to satisfy the assumptions in both these cases. The assumption of linearity of regression for the analysis of covariance was examined by plotting practice data against experimental data and appeared to be justified in all the data.

The differences in visibility attributable to different height-width combinations were significant beyond the five per cent level for the 6 and the partial data for the O, and significant beyond the one per cent level for the 3, 4, 7, 9, and the complete data for the O.

Stroke-width differences were significant beyond the one per cent level for both analyses for the 8, but did not reach significance for any other number.

Interactions between height-width combinations and stroke-widths were in no case significant.

The shortest, widest combination of height and width appeared to be the most visible for all numbers taken as a group, but the possibility remains that some numbers might be more visible in a height-width combination still wider. If there were no reason to require that all numbers have the same height and width, then the 0, 3, and 6 would be drawn with width 75 per cent of height, the 4 in either the 60 or 75 per cent width, the 1 in the height in which width is 60 per cent of height, the 2, 7, and 8 in the 60 per cent width, and the 5 and 9 in the 45 per cent width. It has not been definitely established that this would result in a more visible set of numbers, however.

The most visible stroke-width for all the numbers as a group was the narrowest studied. If stroke-width were accepted as variable among the digits, then the 1, 2, 3, 4, 5, and 7 would be drawn in the widest stroke-width studied, and the 0, 6, 8, and 9 would be drawn in the narrowest stroke-width.

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PSYCHOLOGY, CLINICAL

PERCEPTION OF HOMOSEXUAL WORDS IN PARANOID SCHIZOPHRENIA

(Publication No. 4691)

Paul George Daston, Ph.D.
Michigan State College, 1952

The study was undertaken to investigate the relationship postulated in psychoanalytic theory between paranoid schizophrenia and homosexual impulses (2). The orientation for the study was derived from psychoanalytic theory and research in the area of selective perception. As a measure of selective perception, time required for correct recognition of various classes of tachistoscopically-presented words was used, previous research having indicated that stimuli pertaining to areas of individual concern are recognized more rapidly than "neutral" stimuli (1). Rapid recognition occurs presumably as a function of greater individual familiarity with stimuli relating to the areas of concern to him. It was held that motivational variables were involved in the determination of areas of individual concern, and that the interaction of motivational with perceptual variables would affect perceptually-mediated response. If homosexuality was an area of concern for paranoid individuals, words reflecting homosexuality would be recognized more rapidly by paranoid individuals than by individuals less concerned by homosexuality.

Three groups of subjects were employed in the study: paranoid schizophrenics, unclassified schizophrenics, and normals. It was held that a relationship

between paranoid schizophrenia and homosexuality would have been demonstrated if:

(a) paranoid schizophrenics correctly recognized words with a homosexual meaning more rapidly than did normals and unclassified schizophrenics;
(b) there were no significant differences in correct recognition times between unclassified schizophrenic and normal subjects to homosexual words;
(c) there were no significant differences in correct recognition times between paranoid schizophrenics and normals to heterosexual words or non-sexual words; and
(d) correct recognition times were independent of word length, familiarity, and affective connotation of the words used.

Words comprising the test list were chosen by a group of judges, who rated them on affectivity, sexuality, and familiarity. Words of five- and six-letters were used, a pretest having indicated differential word length did not affect recognition times.

The following findings were noted, following statistical analysis of the data:

1. Affective value of the words had little effect upon time required for correct word recognition.
2. Paranoid subjects recognized homosexual words significantly faster than did the other two groups of subjects.
3. There were no statistically significant differences between unclassified schizophrenics and normals in recognition times to homosexual words.
4. Differences in recognition times to heterosexual words were not significant among the groups.
5. There were statistically significant differences between paranoid schizophrenic and normals in time required to recognize non-sexual words.

These findings supported the psychoanalytic postulations, in that there was demonstrated a relationship between paranoid aspects of personality functioning and homosexuality. Whether homosexuality was the major area of concern for paranoid individuals was not determined, but there were indications that homosexuality was not the sole area of concern for paranoid individuals.

Principal conclusions were: (a) that homosexuality was of greater concern to paranoid schizophrenic than it was to either unclassified schizophrenics or normals; and (b) the sensitivity of paranoid schizophrenic subjects to homosexual stimuli appeared to be more a function of the paranoid components involved than of schizophrenia.

1. Bruner, J. S. and L. Postman. An Approach to Social Perception. In Dennis, W. (Ed.): Current Trends in Social Psychology. Penna: Univ. of Pittsburgh Press, 1948, pp. 71-118.

2. Freud, S. Psycho-Analytic Notes upon an Autobiographical Account of a Case of Paranoia (Dementia Paranoides). (Translated by Strachey, A. and J. Strachey). In Collected Papers, Vol. III, London: Hogarth Press, 1948, pp. 387-470.

Microfilm copy of complete manuscript of 102 pages, $1.28. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-475.

THE RELATION OF RAIL-WALKING AND OTHER MOTOR PERFORMANCES OF MENTAL DEFECTIVES TO MENTAL AGE AND ETIOLOGICAL TYPE

(Publication No. 4932)

Samuel Roy Heath, Jr., Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: MILES MURPHY

In 1940 the writer made a study involving the relationship between mental and motor deficiency. This study was done at The Training School at Vineland, N. J. One hundred and seventy high grade male inmates were tested on the Rail-Walking Test, a device requiring the subject to walk barefooted heel-to-toe on three wooden rails, in succession four inches, two inches and one inch in width. The individual scores on this test were related to the etiological type of the subject and his performance on the 1916 Stanford-Binet Test in terms of mental age. This investigation revealed two findings when the familial (endogenous) and non-familial (exogenous) etiological groups were compared:

1. The familial group was superior in rail-walking performance to the non-familial group.

2. In the familial group a significant positive relationship was found between mental age and Rail-Walking Test score ($r = .66 + .05$); whereas no significant correlation for these two variables was found for the non-familial group ($r = 0 + .07$).

The objectives of the present study were:

1. To repeat the Vineland investigation using a new population of high grade mentally retarded subjects selected according to the same etiological and mental age criteria.

2. To determine whether the findings for the Rail-Walking Test would hold true for other motor tests as well.

One hundred thirty-two subjects were selected from the Wrentham State School (Mass.) and the Mansfield Training School (Conn.) according to the etiological diagnoses made by the medical staff of these two institutions for the mentally deficient. Nearly thirteen hundred male cases were reviewed prior to the final selection of 80 familial and 52 non-familial subjects. These two groups were then tested on the Rail-Walking Test and seven other motor tests. These two groups were equated for mental and chronological age prior to the use of the battery of eight motor tests.

It was found that compared to the other motor

tests that the Rail-Walking Test is most conspicuous for its differential relationship to the familial and non-familial groups. Of the eight tests it shows the most significant difference in mean score between the two etiological groups; it shows the highest correlation with the mental age factor in the familial group while maintaining a non-significant correlation with mental age in the non-familial group; and finally in a factor analysis study it shows the most radical difference in factorial composition between the two etiological groups.

It was hypothesized that one factor which may be differentially affecting the rail-walking performance of the two etiological groups is the degree of ego-involvement in this task in contrast to the other motor tests.

The following conclusions were drawn from this study:

1. Results of the Vineland study are confirmed.
2. Superiority of familial over non-familial type is common in motor test performance.
3. High correlation between Stanford-Binet mental age and motor score in the familial group is not common among motor tests. Among the motor tests a low positive correlation between mental age and test score is the more common finding in both familial and non-familial groups of defectives.

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LEARNING AND RETENTION OF WORDS OF SEXUAL AND NONSEXUAL MEANING

(Publication No. 4941)

Maurice G. Kott, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: FRANCIS W. IRWIN

Freud's concept of repression was the source of two hypotheses:

Hypothesis I. Associates to sexual words will be learned and retained less efficiently than associates to neutral or unpleasant words.

Hypothesis II. Anxious subjects will show a greater relative difficulty in learning and retention of associates to sexual words as compared with associates to neutral and unpleasant words than will normal subjects.

Sixty normal Ss and 60 hospitalized anxious Ss participated in the experiment. The Ss were required to learn paired word-nonsense syllable associates to a criterion. The nonsense syllables were associated in various subgroups with the words of three lists, sexual, unpleasant, and neutral. Following a rest period the Ss were required to recall the nonsense syllable associated with the stimulus word and then relearn to the original criterion those pairs not correctly recalled.

The learning, recall, and relearning scores were treated by analyses of variance and covariance. These reveal no overall significant differences between groups or among lists. Consequently, Hypothesis I was rejected. The interaction, lists x groups, was of a consistent pattern and in some instances at a significant level. The anxious group was more efficient in learning and retention of associates to sexual words than associates to neutral and unpleasant words, while the normal group was less efficient in the learning and retention of associates to sexual words than associates to control words. Since the interaction was in an opposite direction to that anticipated, Hypothesis II was rejected. A suggested explanation of the existing interaction was made in terms of reaction formation.

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THE RELATION OF AFTER-IMAGE DURATION TO CERTAIN ASPECTS OF PERSONALITY

(Publication No. 4502)

Harry Levinson, Ph.D.
University of Kansas, 1952

Problem

To determine if experiences which have neither specific emotion-arousing connotations nor particular importance as cues to perceptual orientation in space are perceived by a person in such a manner that they are consonant with his psychological structure.

Subjects

Twenty-six students in the Menninger Foundation School for Psychiatric Aides.

Procedure

The subjects were given the booklet form of the MMPI and the Higher Form of the Otis Self-Administering Intelligence Test. Each was also tested for visual acuity on the Snellen Chart. Each subject was tested for after-image duration after he had completed his day's work at 3:30 p.m. The subject was seated with his chin on a chin rest. A three-inch square red field superimposed on a white field seven and one-half inches square was exposed to the subject for 50 sec. at a time ten consecutive times at a distance of 60 in. from the subject, with a one-minute rest interval between each exposure. The negative after-image was projected on a gray screen immediately behind the stimulus apparatus. The subject pressed a key connected with a Standard Electric Timer to record the duration of the image. The subjects were tested again at the same time of day for flicker-fusion level and after-image brightness threshold. Flicker-fusion levels were obtained by means of a Strobotac and after-image thresholds by means of an episcotister. Ten flicker-fusion measures and ten after-image threshold measures were obtained.

Results

The subjects were divided into two groups, the 13 with the longest mean after-image durations and 13 with the shortest after-image durations. Significant differences were found between the two groups on the Hy (P=1%) and the Pt (P=2%) scales of the MMPI. High scores on the two scales tended to be correlated with long after-image durations (Hy, r = + .53; Pt, r = + .59). Sixteen questions on the two scales differentiated between the groups on the basis of an arbitrarily-chosen difference of three answers to each of the questions by the two groups. No significant relationship was found between after-image duration and age of intelligence. A correlation of -.38 was found between flicker threshold and after-image duration which approached significance at the 5% level. The after-image threshold experiment yielded no information of value.

Conclusions

The duration of the negative after-image as measured in this study may be said to be significantly related to at least two aspects of personality measured by the MMPI: the hysteric and the psychasthenic. More specifically, the duration of the negative after-image apparently tends to be dependent upon the degree to which the perceiving subject has high personal standards and/or is dependent upon the investigator for approval and self-esteem. The duration of the negative after-image in this experiment was thought to be a measure of the efforts made by the subject to adapt to the experimental situation and to the presence of the investigator. Differences in flicker-fusion level were felt to be related also to the subject's motivation in the experimental situation, an hypothesis which was supported by the inverse relationship found between flicker and after-image duration.

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A STUDY OF FACTORS ASSOCIATED WITH THE STABILITY OF VOCATIONAL GOALS IN COLLEGE STUDENTS

(Publication No. 4943)

Archibald MacIntosh, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: MALCOLM G. PRESTON

The study was designed to investigate the vocational aspirations of college students with particular reference to the seriousness with which a college admissions officer might accept statements of vocational aim and level of aspiration made by candidates for admission.

For the entire student body of a small liberal arts college all of the conventional admissions data were assembled. The students were given a questionnaire at the beginning and at the end of a college year seeking information on vocational goal, motives, level of aspiration and other accessory data, as well as the Strong Vocational Interest Blank. Six months after the second questionnaire a sample group of students selected after a study of the results were interviewed to provide additional information not divulged by the questionnaire procedure. The principal dependent variable of the investigation was the constancy with which college students maintain their vocational goals.

The results showed that 70% of the students remained stable on the original goal while 30% changed goals. Those who maintained their goals constantly are largely concentrated in vocations which require preprofessional training and which in our society are relatively popular. Percentage of A's on the Strong Blank for the goal occupation and extra-curricular activity score are the only two variables which distinguish the stable students from those who change. In neither case is the extent of the distinction large enough to permit useful prediction. Specificity within the vocational area does not, in general, serve as a predictor of stability.

The occupations were found to divide logically into three categories defined by the amount of change taking place, but the prediction of change within these categories was no more feasible than it was within the group as a whole. At the level of certain individual occupations (Medicine, Business and Teaching) the distinguishing variables were Scholastic Aptitude Test Score, percentage of A's on the Strong Vocational Interest Blank, and level of aspiration.

A tendency on the part of those who change goals to change again was revealed by the interviews. College work generally, specific courses, and particular teachers exert strong influences on vocational choice. It was further apparent that vocational programs, conferences, and consultation with family, friends, and other advisers exert strong pressures.

The general conclusion was that conventional data available to an admissions officer cannot be regarded as affording any appreciably reliable basis for predicting adherence to stated vocational goals. The study directs attention to the importance of the particular vocation and the relationship of the student to that vocation as factors determining the constancy of this kind of motivation.

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PSYCHOLOGY, EXPERIMENTAL

A FACTOR ANALYSIS OF JUDGMENTS ASSIGNED TO FIVE CLASSES OF VERBALLY DESCRIBED ANGER-AROUSING SITUATIONS

(Publication No. 4938)

Marvin A. Iverson, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: WILLIAM A. SHAW

The present investigation was designed to determine the dimensionality of the meaning of the descriptive term "anger" by ascertaining the functional unities present in a composite of anger judgments. Concurrent with this objective was an attempt to interrelate several distinct types of content commonly associated with anger-arousing situations.

The first experimental procedure involved the systematic sampling of the content contained in the entire range of all possible anger-arousing situations. A review of the psychological literature indicated that the following distinct kinds of stimulus situations were effective in evoking anger behavior: a) intense and/or persistent sensory and physiological stimulation, b) conflict situations, c) conditions of irresolvable frustration, d) threats to self-esteem, and e) situations which constitute deviations from social mores, ethics, and taboos. These five types were designated as content variables and given classificatory definitions. On the basis of such definitions, psychology graduate students content-analyzed verbal descriptions of situations. The first 32 items on which judges showed reliable agreement and which represented the presence and absence of the five variables in all combinations were selected as experimental stimuli.

The second experimental procedure required subjects to evaluate stimuli on a five-step descriptive continuum. They were requested to indicate the degree of anger experienced if actually confronted by the situation described in each item. A sample of 200 male college undergraduates was used.

Experimental stimuli were intercorrelated and a 32 column correlation matrix was derived. A factor analysis revealed a two-factor solution. A method of rotation was employed whereby the first centroid factor was transformed to have maximum correlation with a neutral criterion stimulus. This stimulus represented the absence of anger-arousing content. The second centroid factor was rotated to enclose the remaining experimental stimuli and to have a zero correlation with the first primary axis.

The second rotated factor accounted for the major portion of common variance and correlated significantly with judgments assigned to 27 of the 31 anger-arousing stimuli. Also it distinguished a stimulus with non-anger-arousing from stimuli with anger-arousing content. Furthermore, it exhibited an additive relationship with the five content variables. None of these findings applied to Factor I.. Because of these several characteristics, Factor I was regarded as extraneous to the experimental hypothesis. Conversely, Factor II was identified as a common factor which denoted the presence of a single determining tendency in subjects' anger judgments. In turn, the emotional meaning of anger could be characterized as a general, uni-dimensional phenomenon.

An additional outcome was that Factor II possessed the highest relative relationship with content Variable C and the lowest relationship with Variable A. Therefore, it was concluded that the affective meaning of anger was most likely to be assigned to descriptions of situations which contain insurmountable barriers to the reaching of goals and least likely to arise in connection with sensory or physiological stimulation.

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RELIGION

CHRISTIAN LOVE: CRITIQUE OF TRADITIONAL INTERPRETATIONS AND A SEARCH FOR A NEW ONTOLOGY OF LOVE

(Publication No. 4589)

Herta Hildegard Pauly, Ph.D.
Columbia University, 1952

This dissertation is a critical appraisal of certain aspects of Christian love. It is part of the writer's thesis that despite the variety of its interpretations these exhibit a high degree of unanimity in denying the relevance of certain phenomenal forms of love to that love which is thought to be uniquely Christian. This applies especially to mutual, preferential and erotic love and forms connected with these. The metaphysical basis of their omission is, we believe (1) a residual body-spirit dualism, and (2) the assumption that Christian love ought to be phenomenally identical with divine love and hence that human love and divine love are ultimately conflicting.

We believe that the origin of these conceptions can be traced to St. Augustine and that his influence upon the interpretation of the meaning of Christian love has maintained itself to this day. We further believe that the meaning and scope of Christian love

is not merely an academic issue, but that a theological and philosophical scepticism concerning the religious validity of the above-mentioned forms of love has been a frequent source of unnecessary emotional and spiritual disturbance in the lives of Christian people. Both the theoretical and the practical aspects of the issue demand that Christian philosophy reconsider the essential nature and the breadth of Christian love. This makes necessary a revision of the ontology of Christian love in the light of modern philosophical thought. This dissertation is an attempt in that direction.

In order to develop my thesis it proved necessary to devote a large portion of this study to the analysis of representative writings on the subject. The first three chapters are given to St. Augustine alone, Ch. I showing his interpretation of Christian love independent of its special application to mutual and erotic love. In Ch. II his doctrine of marriage is presented, and in the third chapter his interpretation of neighborly love. The last is to show that those aspects of his understanding of Christian love which, we claim, are in need of revision, do not derive entirely from the spirit-body dualism but also from the Neoplatonic-mystical motif in Augustinian thought. The full unfolding of this motif and its negative consequences are shown in the following chapter on mystical love. In the writings of Martin Luther a break with the Augustinian tradition took place, but Luther's interpretation of marriage seems to have succumbed finally to the earlier pattern. Kierkegaard, as well as a number of yet more recent Protestant philosophers, perpetuated the conservative rather than the progressive side of Luther's position. In the remaining chapters of Part II the theses of three modern authors are presented who are critical of the traditional interpretations and affirmative of the alleged "Eros" qualities: Ludwig Klages, Vladimir Solovyev and Alfred Dedo Mueller.

In Part III, based on the material and conclusions of Parts I and II, the crucial issues are pointed out upon which a re-consideration should begin (Ch. XII). We then undertake to approach the interpretation of Christian love by a different method than has usually been followed (Chs. XIII-XV). Instead of making a typological grouping into "Agape" and "Eros" qualities, we subject each of these qualities to an approximately phenomenological analysis. By so doing we intend to show that the "Agape" forms offer no intrinsic guarantee of perfect love. They may even in some cases display (or conceal) the absence of any love. The "Eros" qualities, on the other hand, are usually capable of the "works" of "Agape," showing that "human," including erotic, love, does not, because of being human, lack the religious qualities which make love perfect, when measured by Christian ideals of love. Mutual, preferential and erotic love, moreover, do not as such constitute an alternative to love for God. In the concluding chapter the final question concerning the ontological structure of Christian love is discussed. First, in terms of the traditional metaphysical question: does the affirmation of a uniquely Christian love imply a dualistic, monistic or pluralistic nature of "love" in general, from the point of view both of structural form (descending, ascending, etc.) and "level of the soul" (body, psyche, spirit)? We maintain that the ontology of Christian love cannot be fully defined by means of these distinctions. Inasmuch as God is the ultimate source of Christian love, Agape — as God's love — may be expected to manifest itself in an indeterminate variety of phenomenal forms of His choosing. Human love is sanctified not by the structural form, or level of the soul on which it arises, but by being a response to Him. Christian love, then, is phenomenally plural but ontologically one, insofar as with the various forms of human love is given the possibility of transcending these without, however, dissolving or negating their uniquely human character. Participation in divine love therefore does not mean identity with God, but is made possible despite, and through, His otherness.

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SOCIAL PSYCHOLOGY

PARENTAL STANDARDS OF ADOLESCENT SEXUAL BEHAVIOR: A STUDY OF VALUES IN CONFLICT

(Publication No. 4677)

George William Korber, Ph.D.
Stanford University, 1953

The first objective of this sociopsychological study was to determine whether parents manifest conflicting values concerning the sexual behavior of young unmarried people. To obtain the necessary data 120 parent couples living in a university housing area were each interviewed twice, husbands and wives being interviewed separately.

During the first series of interviews each subject was asked to consider a hypothetical story in which it was assumed that a sixteen-year-old boy and a girl of the same age were inadvertently observed while engaging in an act of heterosexual intercourse. The parents of both of these young people were described as neighbors and intimate friends of the respondents. Each subject was then asked a series of twenty questions concerning what the children's parents should do in this situation.

To minimize the effect of direct recall, the second interview was administered after a ten-day interval. A situation identical to the one depicted in the first interview was presented for consideration,

except that in this instance each respondent was asked to assume the role of parent to one of the young people involved. They were then asked another series of twenty questions, parallel to and equated with the first series. These questions were planned to elicit responses concerning what the responding parents would actually do if confronted by this situation.

An inconsistency score was computed for each subject by totalling the number of discrepancies between the two series of responses to the corresponding items. These inconsistency scores were construed as measures of values in conflict. Approximately 18 per cent of the total number of responses for the study group were found to be inconsistent. Discrepancies on one or more items were found between the corresponding series of replies of all except two of the subjects.

The second objective of the study was to ascertain whether certain factors were associated with the conflicting values demonstrated in the first phase of the study. It was expected, first, that the extent to which the subjects judged their own sexual standards to have changed since they were adolescents would be related to their inconsistency scores. It was also expected that the strength of the subjects' emotional response to the second hypothetical situation, as measured by a Guttman scale, would be associated with their inconsistency scores. Neither of these hypotheses were significantly confirmed in the analysis of the data. The number of disagreements between marital partners in their respective responses to questions asked during the first interview was found to be significantly related to individual inconsistency scores. This finding was not anticipated in designing the study and the data suggested no explanation for it.

A subsequent item and scale analysis indicated that the subjects were significantly less tolerant of the behavior in the hypothetical situation when one of their own children was assumed to have been involved than when the children of friends were considered to have been involved. This differential tolerance for the behavior was found to be significantly associated with inconsistency of response. A low degree of tolerance for the described behavior was also found to be significantly associated with strong emotional response to the situation in which one of the subjects' own children was assumed to have participated in the act of heterosexual intercourse. These findings were tentatively interpreted in terms of the theoretical constructs of "ego-involvement" and "reference group behavior."

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SOCIOLOGY, GENERAL

AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF INTRODUCING WRITING SKILLS TRAINING INTO THE FRAMEWORK OF AN INTRODUCTORY COURSE IN SOCIOLOGY

(Publication No. 4693)

Herbert Lewis Hackett, Ph.D.
Michigan State College, 1952

Purpose

To develop methods to improve the writing of students in Sociology and to test these methods in the Introduction to Sociology course (Sophomore level) at Michigan State College.

Hypothesis

Such methods will improve the general writing ability of students in this course, will improve their skills in certain specific areas, will result in improved grasp and use of content material, and will make the students like the course better.

Procedure

First: The actual writing weaknesses of sociology papers were identified by a reading of 1000 papers, and classified. A brief check list was prepared for use in the marking of papers, as an efficient means of pointing out to students their specific writing problems. This was not a cumulative scale to fix a grade.

Second: A frame of reference was clearly stated and defined by a Guide. It stressed the inter-dependence of many disciplines in the teaching of writing skills, including social-psychology, cultural anthropology, linguistics, semantics, education and child development, as well as English, speech and journalism. The frame of reference was relative, non-prescriptive, functional and based on usage. The Guide served in part to explain the check list in terms of the frame of reference.

Third: Two parallel experiments, with a control and an experimental section each, were set up and assigned to two teachers. The content of each pair of sections was kept constant; the variables for the experimental sections included the use of the check list and Guide in weekly writing assignments, grading of all papers for writing as well as content, enforced rewriting of all papers with a writing grade of less than C, and discussion of writing problems before and after each written exercise. This discussion was based on the problems which had been discovered in a series of pre-experiments, and on actual writing problems as they arose, but it never was divorced from the subject matter of the course. Total class

time for this instruction was about two hours (out of 30 class hours).

Testing

The paired sections were equated on the basis of nine characteristics, including four linguistic and three subject-matter.

Comparisons were made on the writing of students on a written post-test, on improvement from a written pre-test to the post-test, performance on an objective post-test, improvement from an objective pre-test to the post-test, and performance in subject matter on a written post-test. Additional information was obtained from student evaluations of the course, from intensive semi-directive interviews, and from other, more informal, interviews.

Results

The methods used produced significant results, or approached significance, in improving the general writing skill of students (Chi Square and "T" test). Certain specific writing skills on the check list seem not to have been affected by the experiment, although one teacher got significant or near significant results for some skills. Although the specific skills did not give significant differences they tended to favor the experimental groups.

The methods used did not seem to affect the student's grasp of sociology as measured by objective tests but did produce differences which approach significance when measured by written tests.

The experiment did not significantly affect the student's liking for the course although the measures used favor the experimental groups.

Conclusions

General writing ability and ability in specific skills can be improved by the methods used without taking undue class time. The methods are efficient and do not produce a negative attitude on the part of students or negatively affect their grasp of the content of the course.

The method will give varying results when used by different teachers, but seems to be adaptable to teachers not specifically trained in the teaching of writing skills.

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AN EXPERIMENTAL STUDY OF THE EFFECTS OF DIFFERENT TYPES OF COMMUNICATION ON MORALE IN SMALL GROUPS

(Publication No. 4875)

Reginald Arthur Henry Robson, Ph.D.
University of Minnesota, 1952

The subject of this report was a research project which was undertaken for the following three principal purposes:

1. To ascertain the effects on the "morale" of a group of the communication of chosen types of reports concerning the group's progress in the achievement of the group goal, under certain conditions.
2. To test an hypothesis offered as an explanation of such effects on group morale.
3. To experiment with a laboratory technique which has only relatively recently been applied in the field of sociological experiments.

In addition to discussing the above in greater detail, Chapter I of this report included a precise formulation of the main hypotheses mentioned in 2 above.

Chapter II outlined the design of the experiment in considerable detail, together with explanations of the techniques which were used (a) to manipulate the independent variables, and (b) to control other significant variables which were thought to be related to the dependent variables, and therefore whose effects on the latter had to be isolated.

Chapter III presented data for the purpose of demonstrating the effectiveness of the manipulations which were utilized in the experiment and which were outlined in Chapter II. On the basis of these data, we suggested that it was reasonable to infer that the manipulations had, in fact, been successful in achieving the situation desired.

Chapter IV described the differences in the values of the dependent variables that were found between the groups which were different with respect to the two independent variables of valence and subjective estimate used in this study. Various significant differences were found in the values of the dependent variables between the groups which were compared, from which data certain inferences were drawn as to the effect on the dependent variables of group performance and cohesiveness of the communication of different types of reports concerning the group's progress in achieving the group goal.

Chapter V presents the data with respect to the test of the hypotheses which were proposed as explanations of the differences described in Chapter IV. The hypothesized relationships which were most consistently supported by the data were those between:

1. Valence and Persistence (Direct).
2. Valence and Cohesiveness (Direct).

In the High Valent Group Goal Condition:

3. Average Subjective Estimate and Average Productivity for the latter part of the experimental period (Direct).
4. Average Subjective Estimate and Persistence (Direct).
5. Average Subjective Estimate and Cohesiveness (Direct).

In the Low Valent Group Goal Condition:

6. Average Subjective Estimate and Average Productivity for the early part of the experimental period (Inverse).
7. Average Subjective Estimate and Persistence. (Inverse).

Finally, Chapter VI summarized the main features of the previous part of the report and attempted to evaluate the undertaking in terms of the three principal purposes outlined above.

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SOCIOLOGY, FAMILY

THE ACCULTURATION OF THE LITHUANIANS OF CHESTER, PENNSYLVANIA

(Publication No. 4897)

Peter Paul Jonitis, Ph.D.
University of Pennsylvania, 1951

SUPERVISOR: JEREMIAH P. SHAZZOO

This is a study of the acculturation of Lithuanian immigrants. As a consequence of the continuous and persistent process of acculturation and adjustment during the past half century, the structure and functions of the Lithuanian peasant family have undergone a marked change from what they were in Lithuania. These changes have been analyzed in terms of a continuum. The continuum ranges from an unacculturated Old World type to a highly acculturated and urbanized American type of family. The European family represents the unacculturated type, while the second-generation Lithuanian family falls toward the highly acculturated end of the continuum. It is the thesis of this study that these changes are indicators of acculturation.

Part One begins with the Lithuanian peasant family in Lithuania. The following topics are presented: geographical background, home background, family size, general characteristics, courtship and marriage, roles and statuses, interpersonal relations, sex attitudes and personal hygiene, birth and child care, psychosocial traits, divorce and separation, funeral customs, and the causes of immigration to the United States.

Part Two consists of a study of the adjustment of the immigrant Lithuanian family to the urban, industrial environment of Chester. As a result of the impact of American culture, certain changes have been brought about in the family life of the immigrant. The second part of the study is devoted to a contrast between the immigrant family in Chester and the Old World type. The topics presented are the same as in Part One. The parental way of life is also compared with that of the American-born children. An analysis is made of some of the distinctive aspects of acculturation theory with particular reference to Lithuanian immigrants.

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S PEECH, THEATER

THE INTERNATIONAL PHONETIC ALPHABET: ITS BACKGROUNDS AND DEVELOPMENT

(Publication No. 4653)

Robert William Albright, Ph.D.
Stanford University, 1953

The chief purpose of the study was to fulfill the need for a history of the International Phonetic Alphabet, or IPA, as the alphabet is widely used by teachers and students of languages and in the sciences of phonetics and linguistics. In tracing the backgrounds and development of the alphabet, other phonetic alphabets which have been important to the development of the IPA were presented and discussed.

Although the beginnings of phonetic alphabets may be found in ancient writings, the work of sixteenth century English authors was taken as the point of origin for this study, because it was in the sixteenth century that the first serious efforts seem to have been made to construct phonetic alphabets. This judgment is in line with the opinions of authorities such as Otto Jesperson, H. C. K. Wyld and H. G. Fiedler. In treating the earlier work, the attempt was made to evaluate the work of writers like John Hart and Bishop Wilkens on an historical basis that would consider the level of phonetic development at the time their work was done. Judged on this historical basis, the work of the sixteenth and seventeenth century writers was considered to be extremely valuable to the development of phonetic alphabets and the principles upon which they are based.

The IPA itself was traced from its roots in the nineteenth century alphabets of Isaac Pitman, Alexander John Ellis and Henry Sweet. In outlining the development of the IPA, the attempt was made to point out the major characteristics of the changes that occurred in its symbols and in its principles of symbolization. One chapter was devoted to an analysis of the alphabetic principles of the IPA and its system of representing the sounds of languages.

Finally, the growth of the IPA was related in general terms to the history of the times in which it developed. In this connection, special attention was paid to allied fields of study such as linguistics, phonetics and pedagogy.

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THE RISE, DEVELOPMENT, DECLINE AND INFLUENCE OF THE AMERICAN MINSTREL SHOW

(Publication No. 4515)

Frank Costellow Davidson, Ph.D.
New York University, 1952

The general problems of this study were to determine the backgrounds of the American minstrel show; to delineate the events and circumstances that marked its growth and development as a formal professional entertainment; to discover the facts and causes of its decline; and to trace its influences in subsequent forms of dramatic practice.

An account is given of some of the events and circumstances that marked the rise of the minstrel show as a formal professional entertainment. The factors responsible for the growth and development of the minstrel show through the 1850's, when theatres devoted entirely to minstrel shows were established, are related.

It was concluded that the minstrel show is the only indigenous American contribution to the drama, and that the melodies the Negro minstrel inspired are America's only approach to national music. The spontaneity of the minstrel show, its freedom from restraint, its melodies of the southern Negro, did much to break down prejudices against the theatre and to raise the standard of theatrical fare.

The minstrel show is tremendously indebted to the Negro, for without the large Negro population in the South, it is unlikely that the minstrel show would have been born. Unfortunately, the caricature of the Negro as he was pictured by members of the Caucasian race soon came to be accepted as a model. In order to obtain work on the stage, even the Negro was forced to shape himself into this distorted role.

War and financial panic had but little effect on the development of the minstrel show; instead, in the 1850's and 1860's its popularity skyrocketed. The industrial revolution provided new wealth and a new audience. The development of the railway and of steam navigation sent hundreds of minstrel shows into the hinterlands. From 1850 to 1870 it was the most popular form of entertainment in the United States, and even England enjoyed a tremendous vogue of the art.

Critics have argued that the decline of the minstrel show was due to the failure to represent accurately the Negro on the stage; but it seems more plausible that part of the minstrels' very popularity was due to the insistence of the public on the exaggeration and distortion. One reason for the decline was the change in financial structure demanded by managers, who tried to outdo one another in elaborateness of presentation, often with a pompousness entirely foreign to a type of entertainment that depended for success on a native basic freedom. When traveling expenses and cost of stage settings and costumes increased so greatly that the minstrel show was no longer profitable, it collapsed. Actors found more lucrative jobs in vaudeville and burlesque. When the old minstrel performers passed away, there were few new people to take the place of persons who had given the minstrel show its vitality. The tastes of audiences had changed also. Movies, finally, with their low admission prices, made the struggle of the minstrel show to survive an impossibility.

Traceable influences of the minstrel show are present today in the songs, clogs and comedy skits of burlesque shows, vaudeville and musical comedies. The circus clowns and ringmaster (interlocutor) still follow the styles of the early shows. The format of many current radio and television shows includes the interlocutor, generally the Master of Ceremonies, who is the butt of the comedian's jokes.

It is unlikely that the professional minstrel show as a popular evening's entertainment will ever return. And it may be just as well. But its importance as the first entirely American theatrical element cannot be denied.

Microfilm copy of complete manuscript of 276 pages, $3.45. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-487.

THE DEVELOPMENT OF LISTENING COMPREHENSION TESTS FOR MICHIGAN STATE COLLEGE FRESHMEN

(Publication No. 4704)

Clyde Walton Dow, Ed.D.
Michigan State College, 1952

Purpose

The purpose of this study was to develop a test of listening having the following characteristics: (1) Limited to comprehension; (2) Limited to expository materials; (3) Adapted to first-term freshmen at Michigan State College; (4) Capable of being administered to large groups of students; (5) Short enough to be administered in a fifty minute listening "laboratory"; (6) Constant in presentation at different times; (7) Including a minimum of printed material to be read; (8) Including a maximum of oral material to be heard; (9) Capable of being easily and rapidly scored; (10) Meeting the requirements of good test construction, namely: a. Reliability, b. Validity, and c. Discrimination.

Procedure

First, Three passages ("Instructions for Taking the Test," "A Definition of Listening," and "Listening Can Be Taught") were prepared.

Second, implications from a speech text and four reading manuals suggested seven "standardized" foils as indicative of the major aspects of listening comprehension. Briefly, they are: (A) Those concerned with the central idea: (1) Quote. Exact repetition of the central idea. (2) Same central idea, but stated in different words. (3) False, twisted, or wrong statement of central idea. (B) Those concerned with details: (4) Quote. Exact repetition of a detail. (5) Same or similar detail, but stated in different words. (6) False, twisted or wrong statement of a

detail. (C) The one concerned with both central idea and details: (7) Unrelated. Not given nor implied in the passage.

Third, passages and foils were submitted to staff members and students in various trial forms to obtain items, and to determine their discrimination and difficulty. Numerous revisions and item analyses were made in arriving at the final form.

Results - Three Tests

Printed instructions, printed foils, and the scripts for materials to be recorded (a. Practice exercise, b. Passage, c. Thirty-two items) are given for each test.

Analysis

Reliabilities of the tests obtained by the test-retest method were: Test I .70, Test II .77, and Test III .71. Validity was studied by several methods: (a) Correlations with two parts of the Nichols Test were found to be .50 for Test I, .51 for Test II, and .81 for Test III. (b) Two of three experts reported favorable inspectional validity. (c) Correlations with A.C.E. psychological scores showed .44 for Test I, .51 for Test II, and .52 for Test III. (d) Correlations with A.C.E. reading scores were Test I, .53, Test II, .39, and Test III, .61. (e) Sex differences were found to be lacking in significance. (f) The tests were found to emphasize factors pertinent to comprehension as taught in the course and as derived from the speech text and reading manuals used in conjunction with the course. (g) The present tests compare favorably with other listening comprehension tests in the factors of reliability and validity considered.

The average difficulty of the tests was found to be 38.90, 46.87, and 52.43 respectively. Therefore two of the three tests, in their present form, meet the purpose for which they were developed.

Microfilm copy of complete manuscript of 265 pages, $3.31. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-488.

THE HOMILETIC RHETORIC OF HUGH BLAIR

(Publication No. 4667)

David McMurray Grant, Ph.D.
Stanford University, 1953

The purpose of this study is to present a critical appraisal of the preaching of Hugh Blair, Scottish rhetorician and preacher of the eighteenth century, in the light of what he said about homiletics. To that end, these questions were raised: 1) What did Blair say about homiletics? 2) What methods did Blair use in his preaching? 3) How closely did Blair follow his own theory of homiletics?

The questions are considered as they relate to the divisions of homiletics: sources of ideas, texts and subjects, proofs, arrangement, style, and delivery.

In Blair's view the function of preaching must be the betterment of the listener. When his sermons are related to what he thought should be the purpose of preaching, it is apparent that he attempted to improve the conduct of his audience.

Blair used both deductive and inductive methods in his sermons, but the deductive was more commonly employed. His emotional proofs were directed chiefly to the topics of duty, happiness, and self-interest. His ethical proof was achieved through references to his own honesty, his humility and good will, and his reputation as a minister over a period of many years. Although he discouraged the formal study of logic, topics and emotion, Blair studied his subject and the probable experiences of his listeners until he acquired those emotional appeals and methods of reasoning which he thought would be most effective.

The arrangement of the sermons reflects a close dependence upon classical theory and post-Reformation homiletics. So precise is the arrangement that one is aware of the organization, often at the expense of the content. The argumentative part of the sermons is often too long and contains too many arguments for the easy retention of his hearers.

If one follows Blair's own classification of style, one may say that his sermons lie midway between the diffuse and the concise; between the nervous and the feeble; between the plain and the neat; and between the natural and the affected, but somewhat nearer the affected. Blair was very sensitive to Scotticisms and to the rising Scottish interest in the English language; perhaps for this reason in the sermons are units of thought which appear too artful, too considerate of forms and of language structure. Blair's theory of style as a part of the communication of meaning was both a reflection of classical learning and of the preferences of his own era.

The final estimate of Blair's homiletic rhetoric must be this: he taught a theory of homiletics which was in the classical tradition, but tempered in its approach to the problem of proof. He preached sermons widely approved in his own day, and his sermons conform to what he taught that a sermon should be. Only on the matter of style is it possible to doubt that he followed his own precepts; his skill in using language is often too obvious, whereas the true art of style cannot be apparent.

Hugh Blair's position in the history of homiletics and rhetoric should be reconsidered. He reinterpreted the classical doctrines for his own age in such a way that they are guides to modern homiletic criticism, which is tempered by both classical tradition and the contributions of experimental research.

Microfilm copy of complete manuscript of 299 pages, $3.74. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-489.

A HISTORY OF THE NEW THEATRE, NEW YORK, 1909-1911

(Publication No. 4672)

John Henry Jennings, Ph.D.
Stanford University, 1953

This essay examines the available data related to the activity of an organization which attempted to establish a national theatre in America, and inquires into the causes for its failure. Many of the materials for the study of this unique chapter in the history of the American theatre are documents, letters, records, and diaries written by persons associated with the New Theatre. They have not been consulted by former writers on the subject. The first half of the essay deals with the antecedents of the New Theatre and with preparations made by its founders and their representatives for its opening performances. This section introduces the persons whose theories determined the proportions of the monumental New Theatre building, which inhibited the success of the enterprise. A second section examines the critical reaction of the press to the twenty-two productions offered at the theatre, and to a number of them taken on tour. A final chapter draws conclusions which point out the complex causes for the failure of this promising venture.

Abortive attempts to establish an American national theatre had been made by other men before Heinrich Conried, Director of the Metropolitan Opera Company, persuaded Otto H. Kahn and other opera sponsors that a national theatre offering light opera and drama would succeed in New York. Although Kahn and his fellow Founders of the New Theatre accepted many of Conried's ideas, they did not wish him to manage the enterprise. It was not until the construction of the huge theatre was well advanced that the Founders learned, while interviewing prospective directors, that in the opinion of men whose primary interest was dramatic repertory, the size and shape of the auditorium of the New Theatre were unsuitable for the production of drama. Winthrop Ames, who was appointed Director of the theatre, found himself urged by circumstances to compromise numerous principles fundamental to the ideal operation of a resident stock repertory company. These circumstances were largely the result of conflicting elements in the policies of the Founders, and they were aggravated by the hostility of the press to what it regarded as an affectation of artistic and social superiority on the part of the men responsible for the enterprise. A portion of the press was also hostile to Lee Shubert, the business manager of the New Theatre, who, while associated with this altruistic enterprise, was at the same time engaged in gaining control of a chain of theatres in opposition to those controlled by a rival organization.

In spite of many adversities, Ames produced a number of plays for which the mounting and the ensemble acting were generally acknowledged to surpass the achievements of commercial theatre managers. After the first season, productions of light opera were no longer presented, and plans were formulated for the construction of a smaller theatre to house the dramatic company. Meanwhile, the losses incurred by the maintenance of the large theatre and the spectacular mounting of productions were discovered to exceed the Founders' anticipations, and when Ames resigned the directorship at the end of the second season, the entire project was abandoned.

Microfilm copy of complete manuscript of 281 pages, $3.51. Enlargements 6" x 8", 10¢ per page. Library of Congress card number Mic A53-490.

EXPERIMENTAL STUDY OF SPOKEN COMMUNICATIONS: THE EFFECTS OF PRESTIGE OF THE SPEAKER AND ACKNOWLEDGMENT OF OPPOSING ARGUMENTS ON AUDIENCE RETENTION AND SHIFT OF OPINION

(Publication No. 4871)

Stanley Fay Paulson, Ph.D.
University of Minnesota, 1952

Purposes of the Study

1. To determine whether or not a college audience registers a greater shift of opinion and higher retention when arguments on both sides of a controversial issue are stated by the speaker than when only arguments on the side he advocates are given;
2. To determine whether or not a college audience registers a greater shift of opinion and higher retention when listening to a speaker with high prestige than when listening to a speaker with low prestige;
3. To determine whether the shifts in opinion and accuracy of retention in the above situations are related to the sex, initial attitudes, intelligence or amount of education of the members of the audience.

Procedure of the Study

By sampling student opinions it was found that they were sharply divided on whether the voting age should be lowered to eighteen years. An argument in favor of lowering the voting age was developed with alternative presentations for matched groups. Subjects were 579 men and 399 women in Speech and Communication classes at the University of Minnesota. The testing was carried out as follows: Before hearing a speech students filled out the Woodward Shift-of-Opinion ballot on which they indicated whether they were in favor, undecided or against the speaker's thesis. Then approximately one-half of the subjects heard a speech advocating lowering the voting age by a speaker introduced as a sophomore at the U. of Minnesota. The other one-half heard the same speech except that in this case the speaker was introduced as a Professor in Political Science at the University of Chicago, a writer in the field and former President of the American Political Science Association.

One-half of those who heard the student and one-half of those who heard the professor heard a "one side" speech — only arguments and evidence in favor

of lowering the voting age. The other half of each group heard a "both sides" speech — arguments on the opposing side as well as the same arguments and evidence in favor of lowering the voting age.

After having heard the recorded speech, each group filled out an Opinion Ballot on which they indicated if opinion had changed. Each subject then took a fifty item multiple choice retention test.

Results of the Study

1. The "both sides" speech did not secure greater shift of opinion than did the "one side" speech.
2. The retention scores of men who heard the "both sides" speech were significantly higher than the men who heard the "one side" speech; the differences were not significant for women.
3. Men who heard the "professor" shifted significantly more than the men who heard the "student"; differences for women were not significant.
4. Retention scores for men and women who heard the "student" and those who heard the "professor" were not significantly different.
5. Women shifted significantly more than the men; men retained significantly more than did the women.
6. Those initially undecided on the controversial issue shifted most, those initially favorable to the speaker's thesis next most, and those initially unfavorable shifted least, differences in each case being significant.
7. Those initially favorable to the speaker's thesis had significantly higher retention scores than those initially unfavorable.
8. Those who shifted in opinion had significantly higher mean scores in retention than those who did not shift.

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A RHETORICAL CRITICISM OF DAVID STARR JORDAN'S ADDRESSES ON EDUCATION

(Publication No. 4687)

William Stephen Smith, Ph.D.
Stanford University, 1953

The criticism of David Starr Jordan as an educational spokesman includes an investigation of his background for speaking, the educational setting into which he injected his ideas, the ideas that he presented, and the means he used to make these ideas effective.

The investigation of his background for speaking reveals that Jordan was unusually gifted with native talent necessary to effective speaking, that his studies at Cornell and his experiences as a teacher and educational administrator prepared him well to speak on educational subjects. Although he had no specific speech training, his teaching and speaking allowed him to develop an art of oratory that was highly effective. His wide reading, acquaintances with many important persons, unusual curiosity, and excellent memory provided him with a great fund of knowledge for his speeches.

The period in history in which Jordan spoke also contributed to his success as an educational orator. During that period a new movement in education was taking place. Jordan's support of the "reformers" increased his popularity and effectiveness.

The ideas Jordan expresses in his addresses are often philosophical in nature; they are sound, but removed to a degree from the specific problems of every-day application. Totally, they express a consistent philosophy of education. Jordan spoke not as an educational philosopher, however, but rather in support of the new system of education being established.

The means Jordan uses to make his ideas effective are varied and, in many respects, skillfully employed. He relies heavily on explanation; his use of exposition includes almost every possible device; his description and narration are exceptionally well presented in support of his ideas. Jordan's strongest means of confirmation for his ideas is emotional appeal directed at pride in the dignity of man, at pride in the common American ideals, and many human emotions. Although Jordan's ethical appeal was tremendous, he employs ways of enhancing it by demonstrating to his audience his exemplary character, his remarkable intelligence, and his good will toward his audiences. Jordan's mastery of the English language, his ability to choose short but graphic words, his use of maxims, and his simple style also contribute substantially to his effectiveness.

Other elements of Jordan's speechcraft are weak. These include logical appeals, organization, and delivery. The first weakness is minimized by his strong ethical appeal. The second is offset to a degree by his choice of simple words and simple sentence structure. Jordan used little or no bodily action. He spoke in a conversational tone, practically without variation, however. More noticeable to the critic than to his audiences, perhaps, is Jordan's tendency to repeat himself.

Of special value to the student of rhetoric, the following conclusions can be drawn from the study of Jordan's speeches: 1) Jordan employed public address as a necessary tool in his work as a practical educational administrator. 2) Through necessity, and without formal speech training, Jordan developed an art of speech that was highly acceptable. 3) The value of the various means of support employed varied with the purposes of Jordan's speeches. 4) Jordan was a successful and effective speaker although he attained a small degree of proficiency in delivery.

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THE ANATOMY OF THE CEPHALIC REGION OF A CENTIPEDE PSEUDOLITHOBIUS MEGALOPORUS (STUXBERG) (CHILOPODA)

(Publication No. 4655)

Arnold George Applegarth, Ph.D.
Stanford University, 1953

It has been the intention, in developing this study, to obtain results concerning the facts of bodily organization of a centipede which are precise and can be relied upon by future workers when the time arrives for applying these results to broader biological questions, such as those involving the lines of descent of the various groups of Arthropoda, their relationships, and how the processes of evolution have operated in the development of these groups from one to another.

The study is primarily concerned with the morphology of the head and poison claws, but also includes some information on the tracheal system, legs, and dorsal intersegmental muscles.

The work was done by means of dissections made with the aid of binocular dissecting microscopes with powers to x146. Twenty-seven plates are included in the paper.

Although no definite conclusions concerning the possible phylogeny of the Chilopoda have been reached, there are some findings listed below which clarify somewhat the relationship of centipedes to other Arthropoda. General conclusions reached were:

1. The resemblance of the head region to that of an insect is sufficiently close to permit general homologies definitely to be recognized.

2. The idea that the Chilopoda are to be placed somewhere back in the line which ultimately led to the insects seems reasonable, although precise homologies, such as those of individual muscles, cannot be determined with any certainty.

3. The Chilopoda, which in many respects are generalized in their structure, have entered upon specializations of their own which have no counterpart in any of the insects.

4. The only individual structure in regard to which the Chilopoda throw any new light on insect morphology is the tentorium. Here is offered a basis for some understanding of how this structure arose in the insects.

5. In the abundance of their muscles the Chilopoda seem to be much more generalized than do the insects, the suggestion being that they and the insects have developed by the loss and fusion of structures, a path which the insects have followed much further than have the centipedes.

6. The presence of nerves apparently belonging to segment three suggests a resemblance to the Polychaeta much greater, at least in respect to this one point, than has yet been described for any other Arthropod.

7. The sutures of the head suggest so strongly the pattern which occurs in the insects that the conclusion can scarcely be avoided that here we have to do with essentially the same developments. This pattern includes the reduction of the dorsal elements of both the first and second maxillae.

8. The question of how the point of insertion of a muscle in an Arthropod is definitely to be differentiated from the point of origin has been approached from the viewpoint of determining the innervation of the muscle, and a general principle is proposed to cover this problem.

9. The significance of many of the facts concerning the anatomy of this centipede which are here presented will become apparent only when further studies have been completed on members of certain other groups, such as the Protura and the Thysanura.

10. The idea contained in "Williston's law" or generalization has been for the first time adverted to in connection with the comparative morphology of the Arthropoda. It is suggested that in further work the applicability of this generalization deserves to be considered.

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BIOLOGY, ECOLOGY, AND DISTRIBUTION OF THE LEAFHOPPERS Dalbulus elimatus (BALL) AND Dalbulus maidis (DeL. & W.) TWO KNOWN VECTORS OF THE VIRUS CAUSING CORN STUNT IN MEXICO

(Publication No. 4841)

Douglas Barnes, Ph.D.
University of Minnesota, 1952

Dalbulus elimatus and D. maidis have previously been shown to be highly efficient vectors of the virus which causes corn stunt. The disease is quite widespread throughout Mexico but its incidence is relatively low and often quite localized.

The genus Dalbulus, family Deltocephalinae, includes at the present time 6 species, all of which occur in Mexico. Of the immature stages it is only possible to differentiate the fourth and fifth nymphal instars of D. elimatus from the corresponding instars of D. maidis. This is done on the basis of body color pattern.

In the field at Chapingo in the State of Mexico it was found during the summer that the incubation period for eggs of D. elimatus and D. maidis in corn plants was about 23 days and the developmental period for the nymphs was about 33 days. During the dry winter season the egg incubation period and nymphal developmental period for these 2 species reared on corn and wheat increased to 36-38 days, and 55-60 days respectively.

Adult females of both species will not oviposit unless they have mated and it has been observed that they need be fertilized only once to produce fertile eggs throughout their lives. The preoviposition

period varies from 1 to 7 days for D. elimatus, and from 4 to 5 days for D. maidis. The fecundity and egg viability of the 2 species is relatively high.

"Host plants" are those plants in which female leafhoppers deposit eggs and on which nymphal development occurs. "Food plants" serve only as a source of food. Field and laboratory tests showed that both leafhopper species flourish on cultivated corn and on wild teosinte. D. elimatus breeds with difficulty on wheat and barley. D. maidis is not able to breed on either cereal crop.

Fifteen wild and introduced grasses were tested in the greenhouse as hosts for D. elimatus. Of those only Bromus laciniatus Beal., B. inermis Leyss., and teosinte proved to be true host plants. Oviposition occurred and nymphs hatched but did not develop on Chloris virgata Schwartz, C. submutica, Eragrostis silveana Swallen, and Phaloris sp. The following cultivated crops which commonly occur in Mexico, alfalfa, yellow sweet clover, bur-clover, broad bean, kidney bean, vetch, potatoes, and carrots were found to serve only as food plants for this leafhopper.

In the Highlands of Central Mexico, where D. elimatus predominates, the host plants corn and wheat are produced in the summer and winter respectively. Population studies showed that in the fall following the corn harvest this leafhopper disperses to wild and cultivated plants which serve only as food plants. Low populations are maintained in the host plants wheat and barley during the winter, and in the food plants during the spring. The low initial population in the spring, the relatively long life cycle, and the short growing season are largely responsible for the absence of high populations of D. elimatus on corn at Chapingo.

In Central Mexico D. maidis occurs most commonly in the tropical and semi-tropical conditions below 750 meters altitude. It does not occur above approximately 2000 meters where more temperate climatic conditions prevail. Above 750 meters D. elimatus is most common. The physical environment under which these 2 species occur is described by means of climographs showing the average monthly rainfall and temperature, and by a description of the wild vegetational cover.

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TRANSFAUNATION STUDIES ON THE HOST-SPECIFICITY OF THE ENTERIC PROTOZOA OF AMPHIBIA AND VARIOUS OTHER VERTEBRATES

(Publication No. 4913)

John Cairns, Jr., Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: D. H. WENRICH

Populations of protozoa-free tadpoles were obtained by removal of mature eggs from the frog's uteri under conditions which prevented contamination by intestinal protozoa. The eggs were then artificially inseminated and placed in aquaria free from parasitic protozoa. Most of the experimental work was conducted with these populations. Other parasite-free populations of larval Anura and Urodela were obtained by washing clutches of eggs from spring-fed pools with sterile water, and by replacing the water in rearing aquaria daily with sterile well-aerated spring water until the eggs hatched. Other prospective vertebrate recipients were subjected to ten examinations before being declared free of rectal protozoan parasites. Attempts were made to transfer the fauna of amphibian and other vertebrate donors (snakes, lizards, turtles, and mammals) to these populations.

Each of the following species appears to have morphologically and physiologically identical populations in North American amphibia: Tritrichomonas augusta (Alexeieff), T. batrachorum (Perty), Hexamitus intestinalis Dujardin, Octomastix batrachorum (Swezy), Endolimax ranarum (Epstein and Ilovaiski), and Octomitus intestinalis (?) Prowazek. Successful transfaunations may be anticipated when using these parasites with various combinations of North American amphibian donors and recipients.

Trichomonas prowazeki Alexeieff, Chilomastix caulleryi (Alexeieff), Chilomastix Alexeieff sp., Urophagus intestinalis (?) Alexeieff, Trepomonas Dujardin sp., Karotomorpha bufonis (Dobell), Proteromonas longifilia (Alexeieff), Monocercomonoides Travis sp., Trimitus parvus Grasse, Hexamitus Dujardin sp., and Balantidium helenae Bezzenberger are apparently best adapted to adult amphibia.

The suggestion is made that less harmonious host-parasite relationships exist between adult and larval stages of the same species of amphibia than between comparable stages of different species or genera.

In addition to the results mentioned previously the following data indicate that Tritrichomonas batrachorum is a rather ubiquitous species. First, T. batrachorum of snakes appears to be identical to T. batrachorum of amphibia. Second, T. batrachorum from the clawed toad Xenopus laevis appears to be identical to T. batrachorum of North American amphibia.

Repeated failures to infect the Japanese salamander, Triturus pyrrhogaster, with parasites from North American amphibia, suggest the presence of a physiological barrier that prevents the establishment of these species.

All transfaunations between lizards and amphibians failed, as did those between the latter and turtles. Transfaunation from mammals to amphibia were also unsuccessful.

Host-specificity may not be rigidly determined; and species of enteric protozoa should be based upon morphological distinctions supported, whenever possible, by experimental transfaunations.

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A STUDY OF THE MECHANISM OF ACTIVATION AND NUCLEAR BREAKDOWN IN THE CHAETOPTERUS EGG

(Publication No. 4926)

Lester Goldstein, Ph.D.
University of Pennsylvania, 1953

SUPERVISOR: L. V. HEILBRUNN

A study has been made of the factors involved in the activation of the immature egg of the marine worm Chaetopterus pergamentaceous; and also of the factors involved in the breakdown of the germinal vesicle.

Evidence has been presented to show that the stimulus for activation is not provided by any factor in the sea water environment. The stimulus probably results from a release of the egg from an inhibitory environment present in and around the ovary in the animal. An attempt has been made to characterize the inhibitor in the ovarian environment. Much of the evidence is of a negative nature but the inhibitor has been shown to be heat labile and of small enough molecular size to be dialyzable.

Some facts have been obtained regarding the intracellular mechanisms concerned with activation and nuclear breakdown. Within 2 minutes after the egg is released from the ovary, there is a loss in rigidity of the protoplasmic cortex. The cortical change is apparently associated with a release of bound calcium ions from the cell cortex. Experiments utilizing sodium citrate show that calcium ions are necessary to effect the breakdown of the nucleus. Within 3 minutes after the release of the egg from the ovary, the free calcium ions participate in the activation of some component which acts more directly on the nucleus.

Speculation as to the nature of the calcium activated component led to the hypothesis that it was a proteolytic enzyme, possibly of the trypsin type. Experiments with crystalline trypsin and crystalline soybean trypsin inhibitor showed that the enzyme is capable of producing nuclear breakdown in the absence of calcium. Apparently the enzyme enters the cell since it can function in external media of pH 3.5 - 4.0 (a pH at which the proteolytic action of trypsin is inhibited). Preliminary experiments show that the eggs contain a protease which behaves approximately as postulated.

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TEMPERATURE THRESHOLD OF DEVELOPMENT OF CERTAIN INSECT EGGS UNDER CONSTANT AND VARIABLE CONDITIONS

(Publication No. 4863)

Sping Lin, Ph.D.
University of Minnesota, 1952

It was the purpose of this study to examine some aspects of the threshold of development, namely, the determination of the temperature threshold of development of eggs of two species of insects (i.e., Oncopeltus fasciatus (Dallas) and Tribolium confusum Duv.), the effect of humidity on the threshold temperature, the effect of constant versus alternating temperatures on the threshold temperature, and the amount of development that actually occurs at subthreshold temperatures.

Thousands of eggs of these insects obtained from stock cultures maintained in the laboratory were incubated under constant and variable temperatures at a relative humidity of about 75%. The following results were obtained.

1. Rate-temperature curves for the development of eggs of Oncopeltus and Tribolium through hatching were not rectilinear.

2. The temperature of development for the egg stage of these insects could not be satisfactorily estimated from the rate-temperature curves. By direct experimentation, the thresholds were determined to be 15°C. constant for Oncopeltus eggs and 17°C. constant for Tribolium eggs. These are the lowest temperatures at which the development of these eggs through hatching could be completed.

3. Under favorable conditions, for example at a low relative humidity of 25%, at 15°C., the percentage of Oncopeltus eggs that hatched decreased to zero. The threshold of development can be considered in effect, as having been raised under such conditions.

4. At temperatures slightly below the threshold, partial development of eggs of either species could take place but development could not go to completion.

5. Since Oncopeltus eggs could hatch if:

a. The first 50% of the estimated total developmental time spent at 14°C., the rest at 30°C., or

b. The first 80% of the average total developmental time spent at 20°C., the rest at 14°C., or

c. The first 75-80% of the average total developmental time spent at 30°C., the rest at 14°C., or

d. When the eggs were subjected to daily alternating temperatures of from below to above threshold throughout the developmental period at a mean temperature slightly below the threshold temperature, with total time at the favorable temperature not necessary more than 8% of the whole period.

It can be concluded that temperatures above 14°C. are necessary but either the processes for which they are required are not limited to a particular development stage (e.g. synthesis of some one or more chemicals) or the sensitive stage is in the time period of 50-80% of the average total developmental time.

6. When the eggs were allowed to develop at the threshold temperatures to an advanced stage and

then transferred to a higher temperature (e.g. 30°C.), a longer than expected period at the higher temperature was required to complete development. This seemed to suggest that some retardation of development occurred when the eggs were transferred from the threshold to a higher temperature.

7. Alternating temperatures have the effect of lowering the threshold temperature of development when compared with that which had been determined at a constant temperature.

8. Under the alternating temperatures having a given mean temperature, higher per cent hatching of the eggs always took place than at the corresponding constant temperature.

9. Alternating temperatures above and below the threshold usually gave a calculated acceleration of development but for unknown reasons the numerical values were not repeatable. Alternating temperatures both of which were above the threshold gave less consistent results: sometimes calculations indicated an acceleration, sometimes not.

The concept of temperature threshold of development and the effect of alternating temperatures on the threshold of development were discussed.

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AN INVESTIGATION OF THE HOST-PARASITE RELATIONSHIP OF SCHISTOSOMA MANSONI

(Publication No. 4885)

John Harold Thompson, Jr., Ph.D.
University of Minnesota, 1952

This study deals with resistance to reinfection in common laboratory animals to Schistosoma mansoni, and an experimental investigation of the behavior of the parasite in different hosts with respect to the problem of immunity. In addition to the experiments devoted to host resistance and susceptibility and resistance to reinfection in the albino mouse, golden hamster, albino rat, and guinea pig, one highly susceptible host, the albino mouse, and one highly resistant host, the albino rat, was similarly studied with and without the presence of the spleen.

The demand for large numbers of uninfected and infected snail hosts for the production of cercariae required by the experimental program was met in the utilization of numerous small, balanced aquaria whose success depended upon minimal feeding and the absence of decaying organic materials. An additional advantage of these small units was that concerned with the isolation of groups of snails which required prolonged study but which did not require the space provided by an entire aquarium of the type commonly used.

A further observation which resulted from the demand for large numbers of cercariae was that noted in regard to the re-exposure of the snail host, Australorbus glabratus (Venezuelan origin), to miracidia of Schistosoma mansoni following a primary exposure. It was found that by repeated exposures all members of a given group of snails would become infected and produce cercariae. It was concluded from these observations on re-exposed snails that the infection of the molluscan host is a matter of chance, that resistance to infection is not developed in these snails, and that size of the individual snail and descent from infected parents had no bearing on the results.

Studies on the albino mouse conducted to establish the infectivity of the strain of Schistosoma mansoni used in the experimental procedures confirmed previous reports on the susceptibility of this host animal, and added confirmation to the belief that gradual adaptation of human strains of Schistosoma mansoni to mice is unnecessary in order to infect them. An attempt to protect mice from reinfection with cercariae of mixed sexes by the establishment of a primary infection with female worms alone was unsuccessful, and the secondary exposure resulted in the development of a new infection with the customary pathological picture including egg passage by the host and worm counts in the order of the expected return for the cercarial dosage employed. Albino mice were not protected from exposure to a challenging dose of living cercariae following a course of vaccination with a preparation of whole cercariae, and the expected number of worms developed from the cercarial dosage employed with typical pathology for the infection in mice.

When mice were exposed to cercariae of Schistosoma mansoni more than three times, if the intervals between exposures were between a week and a month, an immunity developed which manifested itself in the absence of development of new larval worms. This, however, did not result in a cure of the animals which died as rapidly as from a single infection.

Re-exposure experiments carried out on two highly susceptible animals, the albino mouse and the golden hamster, and two highly resistant animals, the albino rat and the guinea pig, after the development of mature worms from an initial infection, resulted in the recovery of worms from the second exposure, identified as larval forms, in the same percentage as for the initial infections. Thus no immunity was developed as a result of the initial infection. In albino mice and albino rats, splenectomy did not affect the course of infection or numbers of worms developing, either initially or upon reinfection.

The failure of albino rats and guinea pigs to die after massive initial infection and reinfection is evidently due to a natural resistance which causes the destruction of ova in the tissues and worms in the vessels. Of the two animals, the albino rat is more effective in this regard than the guinea pig. The albino mouse and the golden hamster lack this mechanism.

Multiple re-exposure in the albino rat and the guinea pig produced no indication of immunity but the process of destruction of ova and worms continued throughout the life of the animals. This process saved their lives, not a process of acquired immunity.

From these observations and those of others it may be predicted that man, and perhaps some of his domestic animals, while both may be able to develop some immunity to Schistosoma if re-exposures are light and frequent, as indicated by the experiments on mice, probably are more like the albino rat and guinea pig in their reactions to the infection. Thus there is a constant destruction of parasites and ova taking place in infected men, due to natural resistance. This, more than acquired immunity probably accounts for man's survival in endemic areas.

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A POPULATION STUDY OF YELLOWSTONE BLACKSPOTTED TROUT (Salmo clarkii lewisi Girard)

(Publication No. 4688)

James Paisley Welsh, Ph.D.
Stanford University, 1953

An examination has been made of the qualitative distribution of trout inhabiting the entire course of a creek tributary to Yellowstone Lake, Wyoming during 1950 and 1951. It was determined that Arnica Creek trout were members of two distinct populations; a temporary "spawning" population of migratory adult trout from Yellowstone Lake, and an endemic "resident"* population of young creek trout. "Spawners" within the creek showed a temporal change in distribution from an early-spring occupation of a major part of the creek to a late-summer occupation of only the lowest creek sections. The "resident" trout size and numerical distributions were shown to differ in each of three physiographic regions which characterize Arnica Creek. The uppermost creek region contained the greatest number and weight of trout per unit volume of water. The lowest creek region contained the greatest number of large trout. Relative trout size within each creek region was strongly influenced by intraspecific predation.

A marked change in size, numbers, and distribution of Arnica trout during the warm season was caused by migration of "resident" trout to Yellowstone Lake, heavy natural mortality, and the addition of a new year class of "resident" creek trout. Extensive winter mortality of creek trout was indicated by a comparison of autumn to spring "resident" trout populations within the creek.

Pronounced seasonal changes in size and sex-ratio of adult spawners characterized the four month upstream spawning run. A determination was made of the heavy creek mortality experienced by the spawners. An evaluation of the efficiency of traps used to collect spawners indicated a change is desirable in the method of trout collection.

A qualitative examination of the predominantly nocturnal downstream migration of young "resident" creek trout to Yellowstone Lake indicated that the late-season migrants from the lowest sections of the creek are the most important source of new trout to the Yellowstone Lake trout population originating from Arnica Creek. Sharp temporal changes in the rate of migration and size of migrating "resident" trout occurred during the four month migration run. Migration accounted for only a small amount of the reduction in numbers of fingerling and larger "resident" creek trout which occurred during the warm season.

A preliminary study of trout scales indicated that the "resident" trout from numerous tributary creeks similar to Arnica Creek act as an important source of replenishment to the trout population of Yellowstone Lake. Tag returns data indicated that Arnica Creek trout are a representative and important part of the utilized Yellowstone Lake trout fishery and are of direct concern to any future management programs within the area.

*"Resident" indicates semi-permanent creek habitat.

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DISSERTATION ABSTRACTS

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